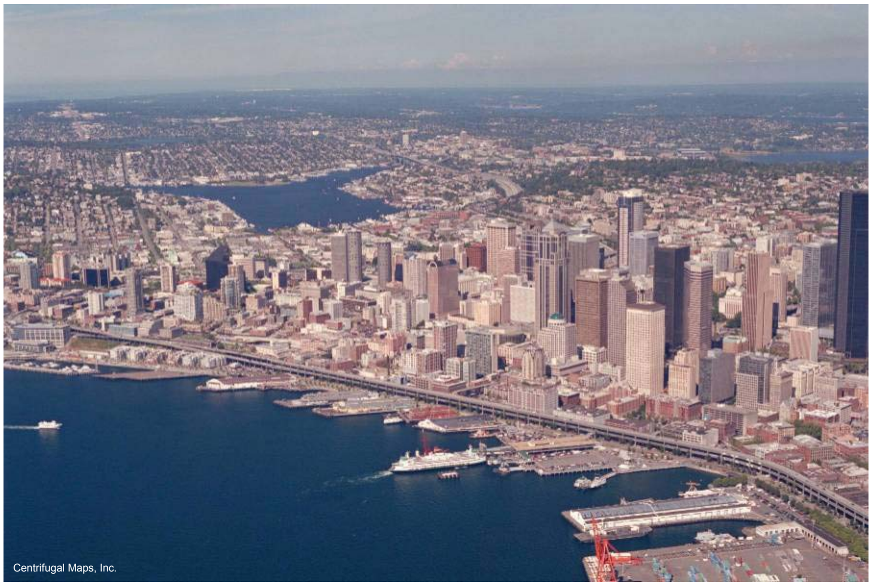
SR 99: ALASKAN WAY VIADUCT PROJECT

Toll Feasibility Study



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Toll Feasibility Study

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The SR 99: Alaskan Way Viaduct Project is a joint effort between the Washington State Department of Transportation (WSDOT) and the City of Seattle. To conduct this project, WSDOT contracted with:

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DISCLAIMER

This Report was prepared by Parsons Brinckerhoff (PB), in accordance with an agreement with the Washington State Department of Transportation (WSDOT). This Report is subject to the terms and conditions contained within the consulting agreement, and is meant to be read as a whole and in conjunction with this disclaimer.

The Report, information contained herein, and any statements contained within the Report, are all based upon information provided to PB by, and obtained from, the Washington State Department of Transportation (WSDOT), the Puget Sound Regional Council (PSRC), and other sources. PB makes and provides no assurance as to the accuracy of any such information or any conclusions that are based thereon, and bears no responsibility for the results of any actions taken on the basis of this Report.

This Toll Feasibility Study for the Alaskan Way Viaduct (AWV) Project was prepared using the best available information and tools at the time of writing; however, the timing is such that this report does not benefit from work-in-progress refinements to the PSRC model, which when completed, will make the model better suited to toll modeling. In addition, other factors may have changed since the time this report was prepared. Assumptions and specifications regarding the proposed AWV toll facility characteristics were developed in collaboration with WSDOT, and may or may not represent most likely scenarios regarding implementation and timing.

The traffic and revenue results presented herein are provided for feasibility considerations and to enlighten further policy discussions, and should not be construed as investment-grade projections. Better tools would need to be developed and applied with rigorous methods including independent review of assumptions at every stage to produce investment-grade projections suitable for securing a credit rating and obtaining toll revenue bond financing.

In the preparation of this Report and the opinions contained herein, PB makes certain assumptions with respect to such conditions that may exist or events that may occur that are subject to change in the future. These assumptions are made for purposes of modeling an AWV toll facility and identifying a range of potential revenue, and are not intended to reflect any official decisions regarding new highway investments. Although PB believes these assumptions to be reasonable for the purposes of this Report at the time of writing, they are dependent upon future events, and actual conditions may differ from those assumed.

EXECUTIVE SUMMARY

With a list of transportation needs that far outstrips available funding, and increasing traffic congestion adversely impacting our region's livability, there is a heightened call for new revenue sources to finance transportation infrastructure. User fees in the form of tolls have been a key element of this discussion, especially for the Puget Sound region's large scale "mega-projects". Tolling has a key advantage over other transportation funding sources, in that it creates a direct linkage between project financing and those who use the roadway. With sufficient autonomy in setting prices, this gives the toll road owner/operator the unique ability to manage traffic flows, prevent congestion, and thus, assure the traveling public of an efficient and reliable route.

One candidate project for user fees is the proposed replacement of the SR-99 Alaskan Way Viaduct and waterfront seawall in downtown Seattle. A combination of age and damage from the Nisqually earthquake in early 2001 suggests that replacement of the roadway and seawall is a more feasible and forward-thinking option than repairing and retrofitting the existing viaduct. Regardless of the approach, the costs of fixing or replacing the Alaskan Way Viaduct (AWV) are likely to be substantial, and scarce funding further warrants a study of the feasibility of tolling.

Study Objectives and Methods

The objective of this study is to model the existing Alaskan Way Viaduct and a representative replacement alternative with tolling in order to develop a range of projected annual revenue. The resulting revenue projections are intended to inform the policy discussion and assist decision-makers in determining if tolling has sufficient revenue potential and/or is an appropriate congestion management tool to merit further research, modeling and analysis.

For the existing facility, it was assumed that tolls would be applied over 4.02 miles, from the SR-99 interchange with Spokane Street in the south to the Battery Street Tunnel portal in the north at Denny Way. Alternative D was used as representative of a maximum build replacement alternative for modeling purposes. In this case, tolls would be applied over 4.93 miles due to a different alignment including a northern terminus at a new tunnel portal at Roy Street.

The Puget Sound Regional Council's regional travel demand model and forecasting procedures were adapted for analyzing the AWV as a toll facility, and represent the practice methods for feasibility purposes currently available. On an unpriced roadway, users consider only their own travel time costs, and not the delay costs they impose on other users. This behavior tends to result in roadway over-consumption and congestion, especially during peak times. The modeling approach employed seeks to implement the economically efficient toll, defined as the external time cost that an additional vehicle imposes on all other vehicles in the traffic stream. As the volume on a roadway approaches capacity, each new vehicle adds an increasing external delay effect on all the others. As such, the economically efficient or "optimal" toll also rises at an increasing rate to maintain good flow conditions, by inducing a sufficient number of would-be road users to seek alternative routes or times to travel.

The regional model adds this external time cost to the individual time cost perceived by each user, and then attempts to assign trips to minimize the overall network travel time. The resulting toll rates, estimated as time costs per mile for three daily periods — peak period/peak direction, peak period/reverse direction, and midday period/both directions — are converted to monetary units by applying the average willingness to pay for delay reduction, expressed in dollars per hour.[1] Research has shown that this value of time is approximately one-half of the average wage rate. For purposes of this study, the value of time was varied between one-third and one-half of the average wage rate for King County to create a range of monetary toll rates. In addition, optimal tolls were computed for both the existing facility and the representative replacement alternative. The overall range of toll rates by time period and direction are shown in Table ES - 1 for opening year (2009) demand levels, along with the total costs for end-to-end travel. All amounts have been inflated to 2009 dollars and reflect the combined results of the two alternatives considered.

Table ES - 1
Range of Toll Rates & Travel Costs by Time Period/Direction in 2009

Time of Day & Travel Direction	Range of Toll Rates (per mile)			Typical End-to-End Travel Cost		
	Min	Average	Max	Peak Dir	Rev Dir	Average
Peak Periods (6 - 9 AM & 3 - 7 PM)	$0.04	$0.10	$0.24	$0.44	$0.18	$0.31
Midday / Evening (9 AM - 3 PM & 7 - 9 PM)	$0.04	$0.04	$0.04			$0.16
Night (9 PM - 6 AM)	— Average Traffic Volumes Too Low to Make Tolling Feasible —					

Note: All amounts are for year of opening demand levels in 2009 dollars.

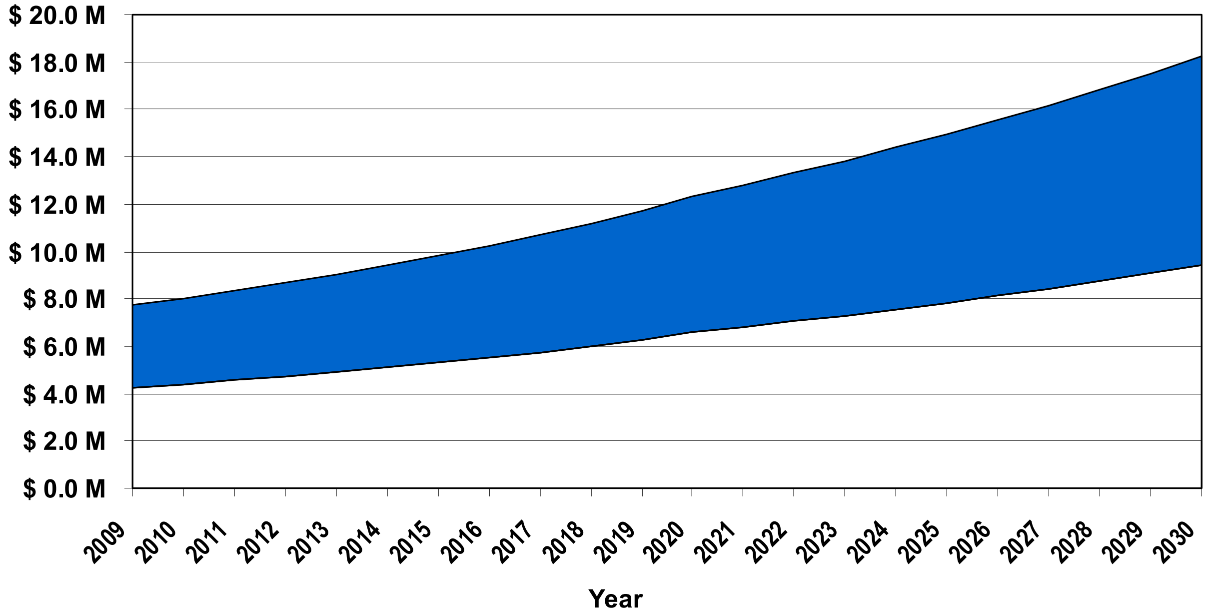
Revenue Projections and Considerations

The above optimal toll rates were applied to the with-toll modeled traffic volumes, expressed as vehicle miles traveled by time period and direction, to yield a range of toll revenue forecasts. This range was widened a bit further by considering whether or not tolls were charged on weekends during the day at the midday/off-peak rate. Figure ES - 1 presents this range of projected revenue, in inflated or year of collection dollars, from the opening year 2009 through the model horizon year of 2030.

The opening year annual revenue "bookends" stretch from approximately $4.3 million to $7.8 million in 2009 dollars. This range forms a boundary around variation in the assumptions for value of time, facility design and access characteristics, and weekend tolling. Furthermore, it may take a few months for opening year demand to ramp-up to the forecast expectations, and thus, initial revenue may be closer to the low half of the spectrum.

[1] Demand during night hours proved to be insufficient to generate tolls much above zero, and thus, night tolls were excluded.

Figure ES - 1
Toll Revenue Range in Inflated Dollars over Both Alternatives



Note that nominal annual revenue is shown growing at an increasing rate over time. This reflects a rising set of optimal toll rates for the AWV replacement facility, which are assumed to escalate for two reasons:

1. Growth in traffic demand will necessitate an increasingly higher optimal toll in order to elicit the appropriate travel behavior and diversion to maintain an economically efficient traffic flow; and

2. Over time, general inflation will increase the average wage rate, and thus users' value of time, the latter of which drives the calculation of the optimal toll rate.

This is an important outcome, and one that will undoubtedly create some political challenges. Though the AWV is not currently that congested, failure to increase optimal toll rates for both inflation and rising demand over time, particularly during peak periods, could eventually lead to the occurrence of congestion on the AWV replacement facility. At a certain point, increased congestion could reduce the efficiency of the facility, and negate part of the reason why tolls are imposed in the first place.

While the methods employed provide ranges for economically efficient tolls and the resultant traffic and revenue, they do not give any indication of the elasticity of demand, and thus cannot be used to pin down how much demand and revenue will change if the toll rates are altered.[2]

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[2] During peak periods, the economically efficient tolls will generally tend to approximate the revenue maximizing toll rates. However, the appropriate tools to test this premise and measure the sensitivity of demand to different tolls by various market segments do not exist at this time. A section of the main report outlines the steps for creating the tools necessary to estimate demand elasticities and prepare "investment grade" revenue forecasts.

Indeed, a much more comprehensive modeling effort, involving substantial market survey research and independent review of all model inputs, would be required to rigorously model demand and produce "investment grade" traffic and toll revenue forecasts. Nonetheless, the resulting range of annual revenues likely encases the true revenue potential, and can thus help decision makers ascertain if additional, more resource-intensive market research and modeling make sense.

Summary of Findings

There is sufficient travel demand and congestion in the Alaskan Way Viaduct corridor to warrant the application of congestion pricing via tolls. At the same time, the relatively short distance combined with the existence of several substitute parallel routes and a lack of peak period reverse direction and off-peak period demand limits the ultimate revenue potential that could be achieved by creating a more extended north-south urban corridor.

Moreover, the success of implementing pricing on any single roadway, including the AWV, will likely be enhanced to the extent that other facilities within the regional highway system adopt pricing management techniques and integrated electronic payment methods. In any event, tolling the AWV will cause some diversion to City streets and I-5, particularly in the absence of a system-wide approach to pricing.

The physical needs for electronic tolling and/or cash payment toll collection have not been analyzed herein. However, there will likely be some significant physical and geographical challenges to implementing a cash payment toll collection option, particularly with multiple access and egress points in both travel directions.

For the Alaskan Way Viaduct or its replacement, application of the economically efficient or optimal per-mile toll rates using only electronic toll collection can be expected to generate gross annual revenue within the range of $4.3 to 7.8 million in the opening year of 2009.

This estimated range excludes probable demand ramp-up effects that would occur during the initial months of operation. Actual revenue will depend on users' values of time as indicative of willingness to pay, and the time periods for which tolls are to be charged. Demand and gross revenue would be approximately 10% higher with a delay-free cash payment method, but manual toll collection congestion impacts and costs may offset much of the additional revenue.

The optimal toll rates will need to increase periodically due to both inflation and growing travel demand, if the roadway is to be managed to yield economically efficient network traffic levels to minimize congestion. Regular toll increases will require that the operating objectives and management policies of the facility be well established and clearly communicated to the public and policy-makers.

Toll diversion to other routes, modes, time of day as well as trip chaining and elimination is expected to average from 13% to 17% across alternatives and analysis years. Localized diversion between various access points may vary outside of this range.

The optimal toll rates seek to minimize overall network travel times. These toll rates are likely to be less than those that would maximize revenue; however, the appropriate research and tools for determining the revenue maximizing tolls do not currently exist. Nonetheless, the revenue maximizing toll structure would likely result in additional diversion and, thus, greater social delay costs due to increased congestion on unpriced facilities.

Each $1 million of annual toll revenue, net of any operating costs, could leverage approximately $7-10 million of capital investment, plus another $1-2 million toward a few years of capitalized debt service costs during construction, via the sale of municipal revenue bonds or similar debt instruments. For the AWV replacement, the spectrum of projected toll revenue equates to a range of capital investment purchasing power with a lower bound of $35 million and an upper bound of $95 million in project costs, including a portion for capitalized debt service.

Exact bond proceeds would depend on debt service coverage requirements, issuance costs, debt terms and duration, and the duration of construction, among other variables.

Toll revenue under Alternative D in 2009 exceeds that of the existing facility by 15%, escalating to 23% by 2030. This is a function of the longer travel distance of Alternative D combined with similar timesavings due to higher design standards. Other build alternatives with similar access points would likely generate toll revenue between these two endpoints.

Design improvements of the build alternatives lead to marginally improved capacity, operating efficiency, and thus, higher demand. This is somewhat offset by longer travel distances, and overall, the build alternatives are likely to result in per-mile toll rates similar to those for the existing facility. However, certain build alternatives may yield somewhat higher revenues, due to the fact that tolls are charged over longer travel distances and for slightly higher traffic volumes.

If the proposed AWV replacement toll facility became part of a larger limited access north-south corridor connecting in with SR-509 in the south and I-5 in the north, then the resulting benefits, demand levels, and thus, toll revenue could be significantly higher.

INTRODUCTION

This report is part of a series of early action efforts addressing the funding and financial issues surrounding the proposed replacement of the SR-99 Alaskan Way Viaduct (AWV). User fees in the form of tolls have been brought to the table as potential source of funding for this project, and this possibility is explored to assist decision-makers in determining if tolling has sufficient revenue potential and/or is an appropriate congestion management tool to warrant further research, modeling and analysis.

From a policy and management standpoint, the implementation of roadway pricing, along with sufficient autonomy to set toll rates, would give the Washington State Department of Transportation the capability to manage congestion and assure the traveling public that the Alaskan Way facility will always operate in a free-flow manner. While tolls may not be popular, they tend to be accepted as an efficient way to finance a portion of transportation infrastructure by connecting a portion of the cost directly to those who use the facility. Moreover, in this era of accountability in government, providers of new transportation infrastructure have a responsibility to the public to manage those resources in a socially efficient manner. The gridlock that is becoming ubiquitous on unmanaged facilities during peak times is predictably inefficient and imposes tremendous delay costs that increase the prices of goods and services and lower the quality of life for everyone.

The following applies a relatively simple and efficient methodology for modeling the AWV as a toll facility, taking into account future travel demands and users' willingness to pay for a facility that provides travel time savings and reliable commute times. It is intended to enlighten the discussion of how tolls might be used in this corridor and assess the revenue potential of implementing an optimal or economically efficient toll structure. And while the revenue forecast ranges offered are adequately precise to inform the decision process as to whether tolls make good technical and political sense, they are not purported to be sufficiently accurate to secure debt financing from the financial markets.

In considering the implementation of user fees in any corridor, it is important to keep in mind that there is a spectrum of operating objectives that can lead to a wide range of pricing strategies. Toll facilities may be operated to maximize revenue, to achieve a revenue target (perhaps linked to debt service and/or operating costs), to maximize throughput, to keep throughput under a ceiling, or to achieve economic efficiency. Economic efficiency and revenue maximization objectives may suggest varying toll rates by time of day, direction, and/or travel distance, whereas a revenue target may be achievable with a relatively simple toll structure. And just as different operating objectives suggest different toll structures, so to does the availability and quality of alternate routes. The greater the delay reduction provided by a priced facility, the more likely the traveling public will be willing to pay for this benefit.

This toll feasibility study of the Alaskan Way Viaduct section of SR-99 is divided into five main sections. Following this introduction are sections on methodology; traffic and toll revenue forecasts; toll experience in Washington State and elsewhere; the steps involved to take this work to the next level; and key findings. A bibliography and an appendix are also provided.

METHODOLOGY

The traffic forecasts for a tolled Alaskan Way Viaduct or replacement facility were developed using the Puget Sound Regional Council's (PSRC) regional travel demand model. The PSRC model is a traditional four-step travel demand model, which has undergone continuous refinement over the past two decades and is currently hosted by the EMME/2 software package. At present, the model incorporates the base year and 2030 land use forecasts from the 2030 Metropolitan Transportation Plan (MTP) adopted by the PSRC in May 2001.

The existing PSRC model was refined for application to the AWV and Trans-Lake Washington projects.[3] This version of the PSRC model was further modified to incorporate specially developed procedures, which were used to simulate and test the viability of tolling one or more Alaskan Way Viaduct replacement alternatives. The approach for toll traffic and revenue modeling described herein represents a balance between the best theoretical technical methods, which are extremely resource and time-intensive to execute, and real world constraints regarding the stage of the project, budget and schedule that dictate a more pragmatic approach. Given a specific aim to determine the range of toll revenue that might be possible to gauge if and how it makes sense to toll this particular facility — as opposed to developing resource-intensive "investment grade" toll revenue forecasts for purposes of securing financing from the bond market — this compromise approach strikes a reasonable balance. The results of this study should help to enlighten the ongoing policy discussion of user fees within the AWV corridor, which may set the stage for further refinement using a more complex methodology and commensurate cost.

The Puget Sound Regional Council (PSRC) approach to modeling tolls was developed by an outside consultant as part of a congestion pricing analysis for the 2030 MTP process. It simulates congestion pricing (tolling to manage flow) within the existing regional modeling framework. Specifically, it approximates the optimal "economically efficient" toll in such a manner that does not require significant market research regarding user demographics and preferences, and without having to re-specify the mode choice components of the model.

In order to fully understand this approach and the interpretation of the economically efficient toll, it is useful to consider the differences between various toll road operating objectives.

Toll Facility Operating Objectives

Differing operating objectives for toll facilities in the U.S. and abroad result in differing "optimal" toll rates or structures based upon the physical, technical and political characteristics of each situation. Four such recurring objectives considered in the modeling of toll facilities, which can at times be either compatible or conflicting, are:

[3] See the Travel Forecasting Model Validation Report for Base Year 1998 prepared for WSDOT by PB, February 2002

1. Throughput maximization;
2. Revenue/profit maximization;
3. Revenue target (i.e., O&M cost plus debt service coverage); and
4. Economic efficiency in terms of congestion management.

Throughput maximization refers to a traffic engineering metric for an individual facility, measured in persons or vehicles per hour. This objective has a certain political appeal when considering the pricing of excess capacity in an HOV lane, the so-called High Occupancy Toll (HOT) lane approach. In a broader sense, this objective attempts to fully utilize the capacity of a facility by serving the most travelers possible. The assumption here is that in an unpriced situation, demand exceeds capacity such that severe congestion results, causing flow to breakdown. Pricing is thus required to maximize throughput and prevent unstable flow conditions. Maximum throughput occurs at the point just prior to flow breakdown, where a marginal increase in demand disrupts traffic flow, causing it to become unstable. For multi-lane freeway facilities, maximum throughput corresponds to traffic volumes that result in speeds of approximately 45 mph. Pricing or other demand management tools must be sufficiently precise and dynamic to prevent flow breakdown under this operating objective. In practice, this operating objective may require the use of a throughput target that approaches but falls short of maximum throughput to provide a sufficient margin of error against crossing over the line into unstable flow conditions. In addition, this objective may not result in the lowest overall travel times, particularly when considering that a higher toll could improve travel times and provide more revenue to be re-invested into capacity improvements or other investments to benefit those who choose not to pay the tolls.

Revenue maximization, or **profit maximization**, which is a form of revenue maximization subject to a cost function, capitalizes on users' willingness to pay for the toll road's attributes — primarily time savings, as well as convenience, reliability/predictability, safety, etc. Tolls are set to maximize net revenue taking into account the relationship between travel time savings and willingness to pay, and only a fraction of all travelers during peak periods will choose to pay. If throughput maximization is at one end of the spectrum of toll rates and volumes, revenue maximization is at the other. The latter objective tends to result in tolls that are notably higher and facility volumes that are notably lower than throughput maximization, along with speeds that tend to be at or near free-flow (speed limit) conditions. However, these attributes lead to high rates of diversion to alternate routes, and overall network travel times will not be minimized.

The **revenue target** objective seeks to achieve a particular threshold, such as sufficient revenue to cover the toll facility's operating and maintenance costs (O&M) and ongoing debt service expenses by a reasonable margin, or alternatively to fund some other objective such as transit service in the same corridor. To the extent that the target is less than the maximum revenue attainable, this objective results in a lower toll rate, and thus higher traffic volumes than the revenue maximizing objective. Also, since debt payments are often fixed, and increasing O&M cost may be offset by growing traffic demand, this objective may be associated with toll rates that do not increase regularly with inflation.

The **economic efficiency** objective uses tolls to correct for the economic distortion or market imperfection that occurs with an unpriced highway facility, resulting in over-consumption of the roadway by users that do not fully perceive all marginal costs of their use. An individual user entering an unpriced roadway perceives only his or her own personal delay or time costs, and not the "external" impacts that his or her vehicle imposes on the traffic flow, despite the fact that this results in additional delay to other users. The latter impact on other travelers is an economic externality — a cost or benefit of a market transaction that is not reflected in the prices consumers and suppliers use to make their decisions. In this case, the market "transaction" is consumption of the road for travel, the consumer is the individual roadway user, the "price" is the individual's travel time or time cost for the road use, and the supplier is the road owner. Because a user's travel choices do not consider the incremental delay they impose on others, a negative externality results.

A price signal in the form of a toll can be used to get the user to recognize the delay they impose on others in making their own travel choices. Tolls are set to the levels that allow only those users whose benefits of travel equal or exceed the marginal costs of travel. In the short run, ignoring pricing issues for auto use, the marginal cost of vehicular travel is the sum of the private travel time cost for that vehicle plus the social delay cost it imposes on other vehicles. In other words, the efficient toll is defined as the one at which the user is paying a price that equals the true short-run marginal cost of travel. Since the user's private costs are "paid" in time, the actual monetary "efficient" toll rate for this objective is the amount that causes users to fully consider the social delay costs that their travel decisions impose on other users of the roadway.

On an uncrowded facility, the addition of another vehicle has a negligible effect on the travel time for the relatively few existing vehicles. With excess capacity, the external cost represented by the economically efficient toll is very low as delay externalities are too insignificant to matter. However, the external cost or incremental delay factor rises with volume and can become quite substantial as the facility approaches capacity, when its performance under congestion deteriorates rapidly with additional demand.

Assuming that users have perfect information about pricing, that toll revenues are used to make cost-beneficial highway investments, and that pricing is ubiquitous, then short-run marginal cost toll pricing allows the road network to operate with maximum net social benefits from the resources used to build and operate roads. In this case, the economically efficient toll rate **maximizes travel time savings**, which for a given volume of traffic, **minimizes total network travel time**.[4] In theory, toll rates resulting from the economic efficiency objective would lie somewhere between the revenue maximizing toll and the throughput maximizing toll.

In practice, this operating objective is difficult to measure and achieve, making it difficult to know where in the spectrum the estimated toll rate lies. Market imperfections, incomplete information, and less than ubiquitous tolling lead to sub-optimal behavior and increased diversion, and may result in toll rates that are higher than intended. Nonetheless, the more diversion opportunities are contained, and the more inelastic demand is (as would be the case during peak periods), the narrower the margin of error.

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[4] Note that the proper measurement of total travel benefits includes the toll revenues since some of the time savings are captures by the tolling authority and returned to all users in the form of cost-beneficial highway investments.

PSRC Modeling Approach to Congestion Pricing

The PSRC approach for simulating tolls/congestion pricing within the regional travel demand modeling framework is theoretically equivalent to the fourth operating objective above, that of economic efficiency. In reaching equilibrium, the traditional four-step PSRC regional model attempts to minimize overall network travel times, subject to various constraints including an essentially fixed level of demand by analysis year. The same is true when tolls are added as an additional time cost or impedance to the network links that represent toll facilities. When demand is assumed to be relatively fixed, minimization of network travel times is equivalent to maximizing travel benefits (time savings), which is the objective of the economically efficient toll rate.

In practice, limitations of the model framework and in the assumptions for applying the economically efficient toll structure rarely yield true economic efficiency. Rather, the model estimate for the economically efficient toll rate may fall in a range between the theoretical revenue maximizing toll rate and the throughput maximizing toll rate. To the extent that tolling is more pervasive or ubiquitous, and/or diversion to alternate (unpriced) routes is minimized, the model estimate for the economically efficient toll will converge on the true value, whereas the more isolated tolling is and the more prevalent are diversion opportunities, the more likely the model estimate for the economically efficient toll will diverge from its true value and approach the revenue maximizing value.

Under the PSRC approach, roadway pricing is introduced by adding an impedance increment to travel times used in the regional model (in the form of a time cost convertible to a monetary toll) that brings the total impedance up to the level that reflects the true incremental impedance, rather than just the impedance perceived by each user. This is done by modifying the mathematical specification of the model's volume-delay function(s) to incorporate not only the "own" delay, but also the incremental delay imposed on other vehicles on a link-by-link basis.[5] The greater impedance perceived on the toll links causes diversion to non-toll links by those users for which the additional toll time cost triggers total costs to exceed the toll facility's benefits. It is important to note that overall demand does not change in response to tolls; rather, the model redistributes demand in a different manner among alternative routes.

Assessment of the Optimal Toll Time Cost

Since the PSRC regional model's volume-delay function is a function of link volume-to-capacity (V/C) ratios, given an assumption for the desired free-flow speed, the optimal toll for each link and direction — expressed as a time cost per mile — can be derived based solely on the model output V/C ratios. The marginal cost of delay equation is provided below, with Table 1 illustrating the one-to-one correspondence between selected V/C ratios and the optimal toll, as a minute per mile time cost, for a facility with an assumed free-flow speed of 50 mph. Figure 1

[5] The reader is referred to PSRC's Transportation Pricing Alternatives Study — Technical Memorandum 3: Simulating Congestion Pricing in EMME/2, which details the mathematics of the modification to the model's volume delay function.

on the following page plots the volume-delay relationships with and without consideration of the external delay costs.

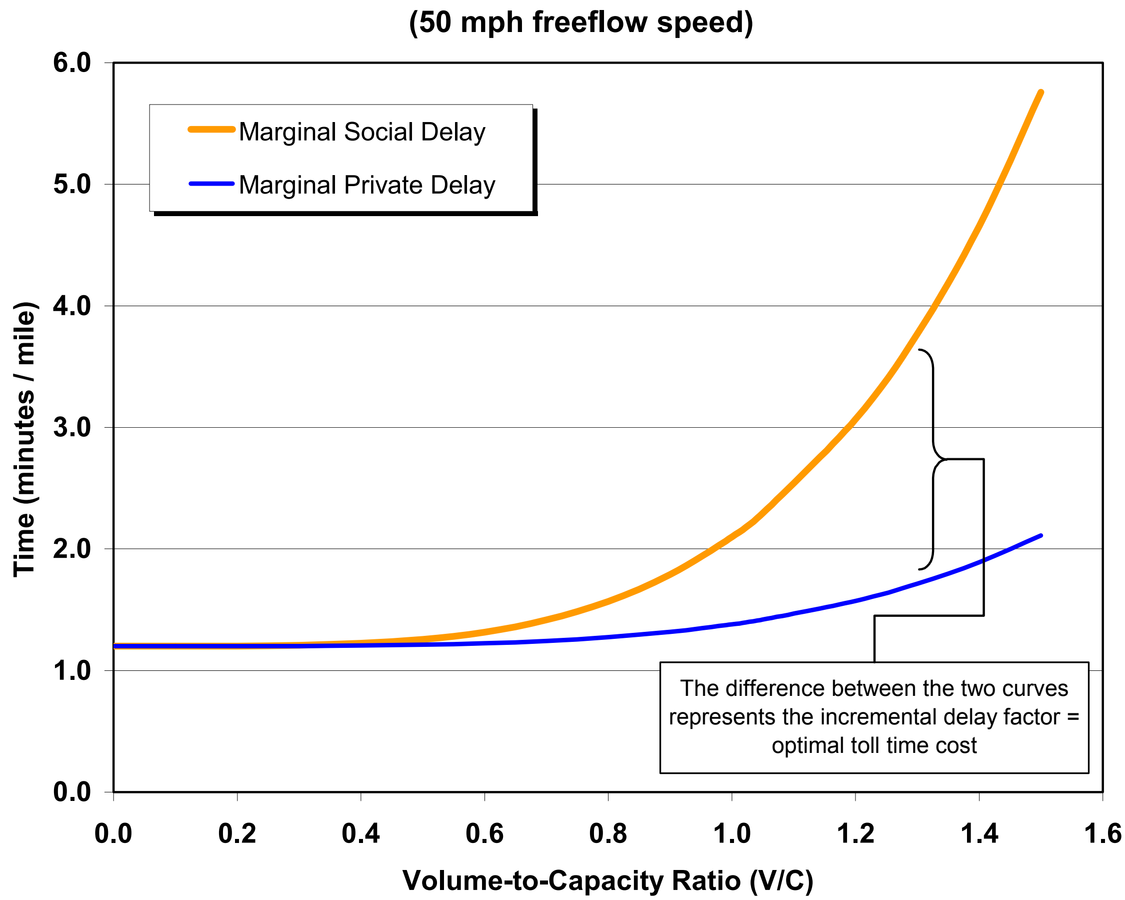
$$m(v) = \underbrace{t_0\left[1 + 0.15\left(\frac{v}{c}\right)^4\right]}_{\text{private "own" delay cost}} + \underbrace{\left[t_0 \cdot 0.6\left(\frac{v}{c}\right)^4\right]}_{\text{external delay cost = toll time cost}}$$

where $m(v)$ = marginal social cost of an additional vehicle
t_0 = free-flow time for a link distance (speed)
v = hourly traffic volume for all lanes
c = hourly capacity, all lanes

Table 1
Optimal Toll Time Costs by V/C Ratio for a 50 mph Facility

V/C Ratio (50 mph free-flow speed facility)	*Incremental Delay Factor = Optimal Toll Time Cost (minutes / mile)*	*V/C Ratio (50 mph free-flow speed facility)*	*Incremental Delay Factor = Optimal Toll Time Cost (minutes / mile)*
0.0	0.000	0.8	0.295
0.1	0.000	0.9	0.472
0.2	0.001	1.0	0.720
0.3	0.006	1.1	0.875
0.4	0.018	1.2	1.493
0.5	0.045	1.3	2.056
0.6	0.093	1.4	2.766
0.7	0.173	1.5	3.645

Figure 1
Volume-Delay Functions for "Own" and "Total" Vehicle Marginal Delay



With regard to Table 1, note that the higher the free-flow (design) speed for the facility, the lower the "optimal" economically efficient toll, all else equal. For example, at a V/C of 0.9, the optimal toll time cost for a 50 mph facility is 0.472 minutes per mile, but drops to 0.394 minutes per mile for a 60 mph facility. At first glance, this result seems counter-intuitive, based on the logic that a higher speed would generate additional time savings over alternative routes, and thus, a higher toll/greater willingness to pay by users. In a static sense, this is true, though in reality, there are several dynamic factors at work that can make the resulting toll rate go either direction. In the example above, it is assumed that the 60 mph facility has a higher capacity than the 50 mph facility.[6] At a V/C ratio of 0.9, the 60 mph facility not only moves more vehicles, but also has greater room for additional vehicles, and thus the time cost that one additional vehicle places on all other vehicles — the optimal toll time cost — is smaller.

Within the regional EMME/2 model framework, a higher free-flow speed assumption not only generates additional time savings, but also increases the hourly capacity of the facility, both of which cause the toll facility to attract new users from alternative routes. New users push

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[6] The design speed in this example could also be a proxy for a facility that is replaced at a higher design standard that results in greater capacity.

volumes upward, and the optimal toll time cost rises with V/C ratios, which in turn causes diversion to other routes, and the process iterates until a new equilibrium is reached with the same overall network travel demand. The new model equilibrium may or may not result in a higher toll time cost per mile, depending on the characteristics of alternative routes, the amount of time savings provided, and the overall levels of demand and congestion in the network.

Estimating Values of Time

Since tolls within the EMME/2 modeling framework are expressed as time costs per mile, it is necessary to convert these to monetary amounts using value of time information. In this context, value of time is defined as a roadway user's willingness to pay to avoid delay, measured in dollars per hour. Value of time has been shown to be closely related to household income levels or average wage rates; in fact, there is evidence that, for commute trips, the ratio of in-vehicle travel time to the wage rate is generally constant across a wide range of income levels. The challenge lies in estimating an appropriate value of time for setting toll rates, because a person's willingness to pay to avoid delay varies by income, trip purpose, peak versus off-peak times of day, travel mode, level of traveling comfort, and even with the level of congestion, which increases travel time uncertainty.

The literature on the value of travel time is extensive and well developed; Small (1999) provides an excellent review of current research. Values of time in research studies are most often determined by conducting stated preference survey (SPS) techniques in which travelers are asked about their willingness to pay for various trade-offs regarding expected travel time and variability. Mode choice models are estimated using the SPS results and the marginal rates of substitution between the costs and travel times of alternatives choices are evaluated. Alternatively, attitudinal panel studies can be used to assess values of time and willingness to pay for delay reduction and/or travel time reliability. A panel study uses repeated surveys of the same sample of users over time to track household income, trip making and travel behavior, route choice, etc., and infers values of time based upon repetitive revealed behavior. This method is particularly useful for assessing values of time for route choices that involve an existing toll facility, and has been employed as part of a series of studies for the I-15 Congestion Pricing Project in San Diego.

In considering the application of tolls on a replacement facility for the Alaskan Way Viaduct, the necessary market research of users and resulting studies have simply not been done for this or any comparable user group in the Puget Sound Region. Given this study's objective to assist decision-makers in determining if tolling looks promising enough to warrant the considerable expense of further research, modeling and analysis, it is necessary to draw on the experience of studies in other areas to estimate values of time for AWV users. This is typically done by relating the value of time to average wage rates in other areas and then applying the resulting proportion to local wage rates.[7] The experience of other toll facilities, especially those that are

[7] In 2000, the average wage rate in King County was $23.66 as estimated from Washington State Employment Security Department data on covered employment and total wages and salaries paid.

dynamically priced adjacent to a parallel unpriced roadway (e.g., SR-91 in Orange County, California) can also provide useful information on willingness to pay.

Several studies have been undertaken to measure value of time. Supernak (2001) summarizes a review of these studies, noting the following.

> Cambridge Systematics (1977) estimated that commuters in the Los Angeles area valued in-vehicle time for non-business travel at 72 percent of their wage. MVA Consultancy (1987) estimated that the value of time of commuters in England varied between 22 and 55 percent of gross wage for high-income earners, and over 100 percent for the lowest income earners. Hensher (1989) estimates a value of time for Australian commuters at 28 percent of their gross wage. Small (1992) summarizes these and other studies, with the conclusion that a "reasonable average value of time for journey to work is 50 percent of the gross wage rate."

One of the challenges in estimating and measuring value of time is understanding what exactly it represents a willingness to pay for, as factors other than delay reduction that may be “hidden” in the value of travel time if not controlled for separately. For example, if other travel characteristics such as comfort/convenience or travel time reliability are not controlled for, then their values may be reflected in the “observed” value of time, making the measure less than ideal for comparing modes and route choices. This can be seen by the fact that congestion often increases the willingness to pay for travel time reductions — here the congestion is increasing willingness to pay to reduce uncertainty, in addition to reducing delay. This suggests that the selection of a appropriate fraction of the prevailing wage rate to serve as the value of time, when based on toll experience elsewhere, should take into account all the attributes users were paying for, which may be more than just delay reduction.

Some interesting results have come to light based upon studies of SR-91. The Cal Poly Applied Research and Development Facilities and Activities (ARDFA) transportation research group conducted a three year series of studies on the impacts of the SR-91 Variable Toll Express Lane facility that opened on December 27, 1995. Objectives included evaluating the impacts of variable-toll express lanes along SR-91 in California while also gaining insight into traveler's reactions to market-based road pricing as a solution to increasing congestion along California's highways.

- There exists a strong correlation between tolled express lane patronage and travel time savings. In spring 1997, the percentage of SR-91 travelers who used the express lanes ranged from about 7% in the mid-day off-peak, when time savings were minimal, to a high of 35% during the peak hour when delay to freeway users was an estimated 12-13 minutes. These observations imply a value of time for SR-91 commuters of $13-14 per hour. However, implied values of time across points in time vary substantially.
- Despite the correlation between travel time savings and the percentage of SR 91 traffic using the toll lanes, some toll lane users choose to use the toll lanes under traffic conditions where the expected value of their time savings is clearly less than the tolls paid. Driving comfort and the perception of greater safety were cited by travelers as the principal supplemental benefits motivating this behavior.

- Surveys conducted with SR-91 peak period travelers provide evidence that many commuters overestimated their true time savings when using the express lanes. This implies that actual values of time may be less than studies have estimated, or that users are "valuing" other travel attributes such as reliability in their travel time savings estimates.

Market research and mode choice model estimation for SR-15 in San Diego suggest a mean value of time of about $16 per hour, although it is noted that the population using this corridor is relatively affluent. In this case, the models did not separately control for travel time reliability, such that the value of "time savings" also includes the value of those unmeasured reliability improvements that generally go along with them for toll facilities.

Values of Time Assumed in the Optimal Toll Rates

Current literature generally converges on a value of time for work trips equal to 50% of average wage rates for the relevant travel market area (Small, 1999 & 1992, and Waters, 1992). It is recognized that this value primarily represents a willingness to pay for delay reduction, but may also include a willingness to pay for reducing uncertainty, improving comfort, and other attributes generally associated with toll facilities. In King County, the most recent available employment data from the Washington State Employment Security Department yields an average wage rate of $23.66 per hour for the year 2000. One-half of this amount, or $11.83, was thus established as the "base value of time" and used to generate toll rates per mile from the optimal toll time costs.

An additional "low value of time" was also established at one-third the average wage rate, or $7.89 per hour for two reasons. First, it is recognized that other previous studies in the Puget Sound region, notably the I-405 EIS effort, have assumed values of time closer to one-third the average King County wage rate. Second, a "half wage rate" value of time may include willingness-to-pay factors for other travel attributes beyond reducing delay, which may or may not vary between tolled and unpriced routes.

Since the true value of time for AWV users is yet unknown, the use of two values yields a range that likely includes the correct average value. Two time values also yields two sets of optimal toll rates, which helps to bracket the resulting revenue forecasts within a range that is more likely to include the true revenue possible. However, in this context, two sets of optimal toll rates do not allow us to test the toll elasticity of demand nor do they impact the expected traffic volumes. Rather, they merely allow us room for error in estimating users' willingness to pay for delay reduction.

Finally, considering that the replacement for the Alaskan Way will not open for several years, the value(s) of time underlying the set of optimal toll rates will need to be inflated to year-of-opening dollars to yield the correct revenue estimates.

Limitations of the Toll Modeling Approach

A key question raised by policy-makers when considering the implementation of a toll facility is how traffic and revenue will be impacted by changes in toll rates. At heart of this question is the concept of toll elasticity of demand — how travel behavior changes with varying toll rates, holding all other variables constant. Demand is said to be inelastic if a *given percentage increase* in the toll rate results in a *smaller percentage decrease* in traffic volumes. When demand is inelastic, marginal increases in the toll rate will generate additional total revenue. Conversely, when demand is elastic, the resulting percentage drop in demand is larger than the percentage increase in the toll, and overall revenue drops. Normally, the demand for any good or service is inelastic at relatively low prices, but becomes increasingly elastic as prices rise. At some price in between, revenue is maximized.

Although the methodology developed for the PSRC is intended to identify the optimal or economically efficient toll — which most likely does not vary substantially from revenue maximizing toll — it cannot tell us by *how much* demand, and thus, revenue will change at different toll rates.

Detailed market research and the specification of a toll mode choice model — both of which would be required to estimate elasticities of demand — are not part of the PSRC methodology for simulating congestion pricing within the EMME/2 modeling framework. In the event that the revenue results of this feasibility study are sufficient to warrant the further research and expense, a later section of this report discusses the steps required to take the traffic and revenue forecasts to the next level.

Moreover, the regional model may not be very adept at simulating certain types of diversion. In particular, it does not do a good job of modeling trips that would shift to less congested time periods, or perhaps be eliminated or combined with other trips. As such, it may overstate the levels of diversion to alternate routes within a given time period such as the PM peak. Further research and model refinements are needed to get a better handle on diversion and how users will alter their travel behavior when faced with toll charges for travel.

TRAFFIC AND TOLL REVENUE FORECASTS

Given that the purpose of this study is to enlighten the discussion of tolling rather than provide "investment grade" revenue forecasts, a "bookends" approach was taken to projecting toll revenue. This involved varying a number of parameters in order to draw boundaries around the likely revenue potential. Specifically, a "no-action" and a "full replacement" alternative were both modeled as toll facilities, combined with the application of two different sets of optimal toll rates calculated using the two values of time, and last, factoring with and without tolling on weekends. The resulting spectrum of revenues over time can be considered as a pair of bookends, within which the true revenue potential likely lies.

The PSRC EMME/2 travel demand forecast model's networks were prepared for the Baseline "No-Action" and Alternative D scenarios and the model was used to prepare traffic forecasts for the base year (1998) and the forecast year (2030). The model was run with the standard volume-delay function for the case without tolls in order to generate the traffic volumes from which to measure toll diversion impacts and congestion reduction. In addition, the model was run with the modified volume-delay function, which adds the additional impedance corresponding to the external delay component to simulate the case with the optimal toll in place. The corresponding volume-to-capacity (V/C) ratios are used to identify the incremental time costs that correspond to the economically efficient "optimal" toll rates per mile, and the resulting link volumes and distances are used to project toll revenue.

The following presents some general assumptions of the forecasting process, the resulting traffic forecasts, and ranges for the projected toll revenue under the Baseline "No-Action" Alternative and Alternative D.

General Assumptions

Roughly half of the AWV travelers use the facility to gain access to or from downtown, with the remainder using the facility to get through downtown to and from points further north. Given the nature of this travel combined with the methods used to model tolls, it was most appropriate to assume that tolls would be charged on a per-mile basis. In other words, users would be charged only for the distance they travel on the AWV or its successor facility rather than assuming one flat toll rate that simply buys access to the roadway. With electronic toll collection, this assumption poses no technological challenges; however, if manual tolling were to be allowed, then it still may be necessary or practical to charge cash paying customers a flat toll rate corresponding to the entire distance regardless of how far they actually travel.

The traffic and toll revenue forecasts also reflect the assumption of **100% electronic toll collection (ETC)**. This assumption was made to avoid having to model toll transaction time costs inclusive of any queuing delays at the toll plaza that might occur at peak travel times. It was recognized that although the vast majority of vehicle-trips on the AWV are made by regular users who would obtain the necessary ETC vehicle transponders, there will be some infrequent users, visitors, and even regular users who, for whatever reason, will not have transponders and who would thus be excluded from ETC.[8] To account for the relatively small number of non-revenue trips made by such users — without considering alternative payment methods or enforcement mechanisms/costs — and to allow for transit vehicles to travel at no charge, all toll revenue forecasts were reduced by 10%. It is likely that this revenue adjustment more than compensates for the revenue loss of 100% ETC.

If a manual toll payment method were provided, then the aforementioned downward toll revenue adjustment would not be required (excepting a small component for transit vehicles), but the underlying facility demand may also be diminished to the extent that one or more toll plazas add to overall travel times. Similarly, operating and maintenance costs would rise to account for the additional labor and toll plaza facilities required. Moreover, ETC vehicle transponder participation would likely be much lower for infrequent and moderate users than if no cash payments were accepted.

Additional traffic modeling and toll revenue forecasting assumptions follow below. These assumptions are made for purposes of identifying a range of potential revenues, and in no way reflect any official decisions regarding the replacement alternatives.

- The **Baseline "No-Action" Alternative** reflects the existing Alaskan Way Viaduct 's physical characteristics, including lane widths, capacity, 50 mph speed limit, and access points. The toll portion is 4.02 miles from the SR-99 interchange with Spokane Street in the south to the Battery Street Tunnel portal in the north at Denny Way.
- **Alternative D** was modeled as representative of a "maximum construction" replacement facility at the opposite end of the scale from no-action. The alignment stretches 4.93 miles from Spokane Street in the south to Roy Street in the north. Physically, it reflects a cut and cover tunnel for both directions between a portal at Roy Street and a portal at Royal Brougham / SR-519, with various midtown access points in between. More importantly, Alternative D represents a replacement facility with the same number of lanes per direction as the existing facility, but constructed to current design standards in terms of lane widths, geometry and access ramps. These factors allow for marginal increases in speeds and capacities relative to the existing AWV.
- The **forecast horizon** is **2030**, with **2009** the assumed **year of opening** for the new facility. Forecast results between the base year of 1998 and 2030 are used to interpolate volumes, V/C ratios, and optimal toll rates the opening year and other intermediate years.
- The **base year of 1998** employs the existing highway and transit networks (in terms of facilities, capacities and service characteristics) and applies the current origin-destination trip matrix based upon existing land use and transportation system attributes.
- The **future year** employs the 2030 highway and transit network improvements along with the future origin-destination trip matrix based upon the production and attraction

[8] The 407 Express Toll Route in Toronto, Canada is 100% ETC but allows for autos without transponders to be charged tolls via automatic license plate recognition. A bill is sent to the registered vehicle owner for the toll amount (on a per kilometer basis), along with an administrative charge of approximately $1.75 US.

patterns resulting from future population, employment and land use projections within the region. The 2030 highway network included all committed and funded regional projects in the PSRC, WSDOT and local Transportation Improvement Plans. The 2030 transit network includes present service changes since 1998 along with transit operators' six-year plan service improvements through 2007, with transit service assumed to increase at one percent per year thereafter through 2030. In addition, the future transit network assumes the Sound Transit LRT line from SeaTac to Northgate as well as other services in Phase 1 of the Sound Move Plan.

- As previously described, the **value of time** is computed as either one-third (low) or one-half (base) of the annual wage rate for King County, which was $23.66 in the year 2000.
- Three **weekday toll time periods** were modeled — a three hour AM peak period (6AM – 9AM); a four hour PM peak period (3PM – 7PM); and an eight-hour off-peak period composed of six midday hours (9AM – 3 PM) and two evening hours (7PM – 9 PM).
- Three **weekday toll rates** were applied — a peak period, peak direction rate; a peak period, reverse or non-peak direction rate, and a midday rate applied to both directions.
- The **weekend toll time period** was modeled as the 15 hours corresponding to the majority of travel applying the weekday midday toll rate and assuming one-half of the weekday travel demand per weekend day.
- **Optimal toll rates** were computed based upon the V/C ratio for each model link or segment of the project alternatives, and the overall toll rates assigned to each alternative by time period and direction were computed as weighted averages of each link's rate.
- **Time of day traffic distributions and vehicle class shares** were taken from a separate Parsons Brinckerhoff study of truck traffic on the AWV. In accordance with industry practice, **truck toll rates** were assumed to be a multiplier of the auto toll, ranging from 2× to 4× based upon the number of axles (2, 3, and 4+). Truck data for the AWV suggests an average multiplier of 3× be applied to 3.7% of the traffic volume occurring during the 15-hour toll time period.

Baseline "No-Action" Alternative Traffic Projections

Traffic volumes were modeled with and without optimal tolls for all daily time periods. Table A- 3 in the Appendix provides the resulting annual average daily traffic volumes, toll diversion rates, and time period V/C ratios, by model link, for 1998, 2009, and 2030. The model suggests that tolls, if implemented today, would cause approximately 12.6% of AWV daily vehicle trips to divert to alternative routes, with the daily rate of diversion growing to nearly 14% by 2009, the assumed year of opening. By 2030, the model predicts toll route diversion of 16.4% of the unpriced demand. Diversion rates during certain peak times of the day could reach 20%. As overall demand grows, the economically efficient or optimal toll rate would rise to cause a higher rate of diversion necessary to maintain uncongested traffic flow conditions.

Optimal toll rates were then derived from the with-toll modeled traffic volumes and V/C ratios by model link and time period for 1998 and 2030. Table 2 presents these rates — expressed as VMT weighted averages and converted to monetary units per mile in year 2000 dollars — for various time periods and travel directions, under both the low value of time of $7.89 per hour and the base value of time of $11.83 per hour. Optimal toll rates for night-time hours proved to be insignificant due to low demand levels and were consequently set to zero.

Table 2
Average Optimal Toll Rates for the Baseline Alternative (2000 Dollars)

Toll Rates per Mile — Baseline	Base Value of Time		Low Value of Time	
	1998	2030	1998	2030
Off-Peak (Midday) Toll Rate	$0.03	$0.03	$0.02	$0.02
Peak Period/Peak Direction Toll Rate	$0.11	$0.14	$0.07	$0.09
Peak Period/Reverse Direction Toll Rate	$0.04	$0.06	$0.02	$0.04
Night Toll Rate	$0.00	$0.00	$0.00	$0.00

Note that the optimal toll rates in year of collection dollars should increase over time for two reasons:

1. **Growth in traffic demand will necessitate an increasingly higher optimal toll in order to elicit the appropriate travel behavior and diversion to maintain an economically efficient traffic flow; and**

2. **Over time, general inflation will increase the average wage rate, and thus the value of time, the latter of which drives the calculation of the optimal toll rate.**

The results herein assume that the posted toll rates per mile are maintained at their optimal toll levels through annual increases for both inflation as well as rising demand. Clearly, the operating objectives of the toll facility and the flexibility to manage toll rates to prevent congestion — including annual increases that could exceed general inflation — will require education of the decision-makers and implementation of appropriate policies.

A restricted toll structure or a flat-rate toll poses a downside risk that the operative tolls become sub-optimal to the point they no longer manage congestion. The occurrence of congestion on the AWV replacement facility would likely reduce person-throughput, network efficiency, and negate part of the reason why tolls are imposed in the first place.

Taking into account the implementation of tolling only after a new facility could be completed (no sooner than 2009), Table 3 presents the proposed toll rate schedule for the Baseline "No-Action" Alternative using the base value of time of $11.83 per hour. Note that values of time and toll rates by year are expressed in both real terms (denominated by constant year 2000 dollars), and more importantly for revenue purposes, in inflated (year of collection) dollars.[9] Table A- 1 in the Appendix presents this same toll rate schedule for the low value of time of $7.89 per hour.

[9] Inflated amounts were estimated using the February 2002 projections for the Implicit Price Deflator for Personal Consumption index prepared by the Washington State Office of Financial Management and Department of Transportation.

Table 3
Toll Rate per Mile Schedule — Baseline "No-Action" Alternative
(Constant and Inflated Dollars — Base Value of Time)

Year	Constant Year 2000 Dollars				Inflated (Year of Expenditure) Dollars			
	Base Value of Time ($ / hr)	Peak Periods / Peak Direction	Peak Periods / Reverse Direction	Midday/ Evening & Weekend Both Dir	Base Value of Time ($ / hr)	Peak Periods / Peak Direction	Peak Periods / Reverse Direction	Midday & Weekend Both Directions
1998	$11.83	$0.11	$0.04	$0.03	$11.34	$0.10	$0.04	$0.03
1999	$11.83	$0.11	$0.04	$0.03	$11.53	$0.11	$0.04	$0.03
2000	$11.83	$0.11	$0.04	$0.03	$11.83	$0.11	$0.04	$0.03
2001	$11.83	$0.11	$0.04	$0.03	$12.05	$0.11	$0.04	$0.03
2002	$11.83	$0.11	$0.04	$0.03	$12.17	$0.12	$0.04	$0.04
2003	$11.83	$0.11	$0.04	$0.03	$12.43	$0.12	$0.04	$0.04
2004	$11.83	$0.11	$0.04	$0.03	$12.72	$0.12	$0.04	$0.04
2005	$11.83	$0.11	$0.04	$0.03	$13.00	$0.13	$0.05	$0.04
2006	$11.83	$0.12	$0.04	$0.03	$13.29	$0.13	$0.05	$0.04
2007	$11.83	$0.12	$0.04	$0.03	$13.59	$0.13	$0.05	$0.04
2008	$11.83	$0.12	$0.04	$0.03	$13.89	$0.14	$0.05	$0.04
2009	$11.83	$0.12	$0.04	$0.03	$14.20	$0.14	$0.05	$0.04
2010	$11.83	$0.12	$0.05	$0.03	$14.53	$0.15	$0.06	$0.04
2011	$11.83	$0.12	$0.05	$0.03	$14.89	$0.15	$0.06	$0.04
2012	$11.83	$0.12	$0.05	$0.03	$15.30	$0.16	$0.06	$0.04
2013	$11.83	$0.12	$0.05	$0.03	$15.74	$0.16	$0.06	$0.05
2014	$11.83	$0.12	$0.05	$0.03	$16.18	$0.17	$0.07	$0.05
2015	$11.83	$0.12	$0.05	$0.03	$16.65	$0.17	$0.07	$0.05
2016	$11.83	$0.12	$0.05	$0.03	$17.14	$0.18	$0.07	$0.05
2017	$11.83	$0.13	$0.05	$0.03	$17.66	$0.19	$0.08	$0.05
2018	$11.83	$0.13	$0.05	$0.03	$18.25	$0.20	$0.08	$0.05
2019	$11.83	$0.13	$0.05	$0.03	$18.89	$0.20	$0.08	$0.05
2020	$11.83	$0.13	$0.05	$0.03	$19.61	$0.21	$0.09	$0.06
2021	$11.83	$0.13	$0.05	$0.03	$20.09	$0.22	$0.09	$0.06
2022	$11.83	$0.13	$0.06	$0.03	$20.58	$0.23	$0.10	$0.06
2023	$11.83	$0.13	$0.06	$0.03	$21.10	$0.23	$0.10	$0.06
2024	$11.83	$0.13	$0.06	$0.03	$21.64	$0.24	$0.11	$0.06
2025	$11.83	$0.13	$0.06	$0.03	$22.19	$0.25	$0.11	$0.06
2026	$11.83	$0.13	$0.06	$0.03	$22.76	$0.26	$0.12	$0.07
2027	$11.83	$0.14	$0.06	$0.03	$23.36	$0.27	$0.12	$0.07
2028	$11.83	$0.14	$0.06	$0.03	$23.98	$0.28	$0.13	$0.07
2029	$11.83	$0.14	$0.06	$0.03	$24.63	$0.29	$0.13	$0.07
2030	$11.83	$0.14	$0.06	$0.03	$25.29	$0.30	$0.14	$0.07

Note: Toll operations not expected to commence prior to 2009

It is interesting to note that the optimal toll rate for the non-peak or reverse direction during the peak period increases by a larger percentage over time than does the peak period, peak direction toll. The model predicts that higher peak period, peak direction V/C ratios — compared to the peak period, reverse direction V/C ratios — leave less room for demand to grow over time. In addition, much of the peak direction travel is to/from downtown Seattle. The PSRC's regional model assumes that there will be substantial increases in the real (net of inflation) cost of parking in downtown over time, which severely limits growth in vehicle trips to/from downtown. On the other hand, in the reverse/non-peak direction, lower V/C ratios or greater excess capacity currently prevail, demand is less likely to be influenced by rising real parking costs, and thus, higher future traffic growth is possible. This, in turn, leads to more sizeable increases in V/C ratios and optimal toll rates.

Table 4 presents the forecasted weekday and weekend traffic demand from 2009 through 2030, expressed as vehicle miles traveled (VMT). Daily VMT by year is shown for each direction, and is divided between the total daily amount and that which falls during the 15-hour toll period. Approximately 86% of weekday travel, and 77% of weekend travel would be subject to tolls. Table A- 5 in the Appendix provides additional VMT demand information further divided by the three weekday toll time periods (AM peak, midday and PM peak) as well as night hours.

Table 4
Total & Toll Period Daily Vehicle-Miles Traveled — Baseline Alternative

Before ETC Non-Participation / Evasion Adjustments

Year	*Weekday (24 hr)*		*Weekday Tolled (15 hr)*		*Weekend (24 hr)*		*Weekend Tolled (15 hr)*	
	NB	*SB*	*NB*	*SB*	*NB*	*SB*	*NB*	*SB*
	100.0%	*100.0%*	*86.2%*	*85.9%*	*100.0%*	*100.0%*	*77.1%*	*77.1%*
2009	168,523	175,398	145,192	150,620	84,261	87,699	64,979	67,630
2010	169,185	176,091	145,743	151,201	84,592	88,046	65,234	67,898
2011	169,850	176,788	146,296	151,785	84,925	88,394	65,491	68,166
2012	170,518	177,488	146,852	152,372	85,259	88,744	65,749	68,436
2013	171,189	178,192	147,411	152,961	85,595	89,096	66,007	68,707
2014	171,864	178,898	147,972	153,553	85,932	89,449	66,268	68,980
2015	172,542	179,608	148,537	154,148	86,271	89,804	66,529	69,254
2016	173,223	180,321	149,104	154,746	86,612	90,161	66,792	69,529
2017	173,908	181,037	149,673	155,346	86,954	90,519	67,056	69,805
2018	174,596	181,757	150,246	155,949	87,298	90,879	67,321	70,082
2019	175,288	182,480	150,822	156,555	87,644	91,240	67,588	70,361
2020	175,983	183,207	151,400	157,164	87,991	91,603	67,856	70,641
2021	176,681	183,937	151,981	157,776	88,340	91,968	68,125	70,923
2022	177,382	184,670	152,565	158,390	88,691	92,335	68,395	71,205
2023	178,088	185,406	153,152	159,008	89,044	92,703	68,667	71,489
2024	178,796	186,146	153,742	159,628	89,398	93,073	68,941	71,775
2025	179,508	186,890	154,334	160,251	89,754	93,445	69,215	72,061
2026	180,224	187,637	154,930	160,877	90,112	93,818	69,491	72,349
2027	180,943	188,387	155,529	161,506	90,471	94,194	69,768	72,639
2028	181,666	189,141	156,130	162,138	90,833	94,571	70,047	72,929
2029	182,392	189,899	156,735	162,773	91,196	94,949	70,327	73,221
2030	183,122	190,660	157,342	163,411	91,561	95,330	70,608	73,515

Note: Toll operations not expected to commence prior to 2009

Baseline "No-Action" Alternative Toll Revenue Forecasts

With the traffic forecasts converted to weekday and weekend daily VMT by the various toll time periods, the optimal toll rates can be readily applied to generate daily and annual revenue forecasts. A range of revenue that might be possible under the Baseline "No Action" Alternative was considered by varying the value of time underlying the optimal toll rate as well as excluding weekend toll revenues. The low end of the range employs the low value of time and excludes weekend toll revenue while the high end of the range applies the base value of time and adds in weekend revenue. Given the nature of the forecasting methods and the lack of in-depth market research, a concerted effort was made to avoid producing forecast scenarios that might be considered optimistic.

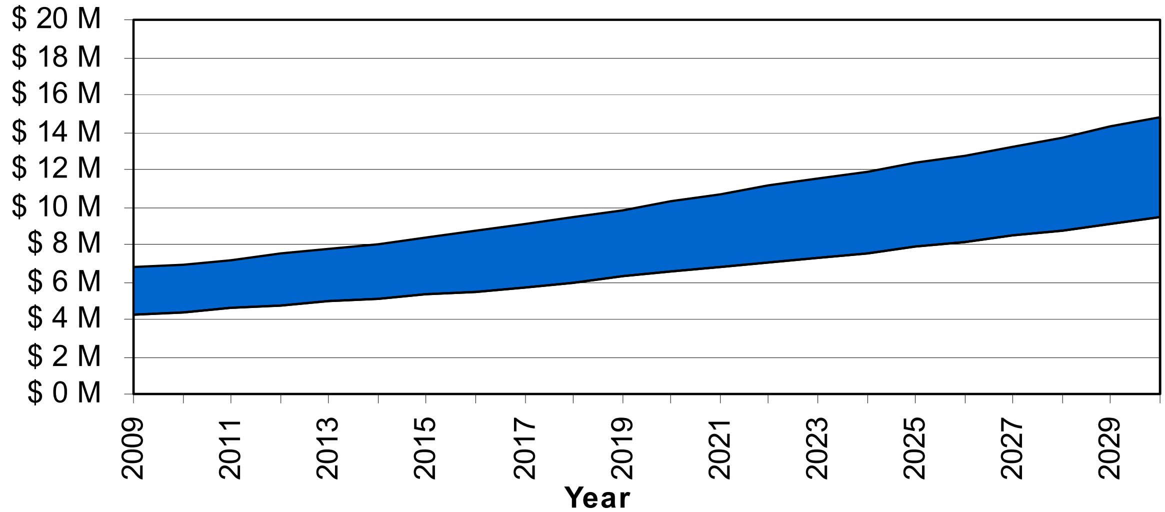
Initial revenue estimates calculated from the daily VMT data by toll period were adjusted upward to reflect the percentage of the traffic representing trucks paying higher tolls and adjusted downward to account for ETC violators, evasion or vehicle transponder non-participation and transit exemptions. Weekday and weekend/holiday daily revenue estimates were then annualized using appropriate factors. The resulting annual toll revenue forecast ranges for the Baseline Alternative in constant and inflated dollars are presented in Table 5. Figure 2 graphically presents the likely range of revenue in inflated or year of collection dollars.

Additional detailed revenue information for the Baseline Alternative can be found in Appendix Table A- 7 expressed in constant dollars, and in Table A- 8 expressed in inflated (year of collection) dollars.

Table 5
Annual Toll Revenue Ranges — Baseline "No Action" Alternative

Year	*Constant Year 2000 Dollars*		*Inflated (Year of Collection) Dollars*	
	Low Time Value No Weekend Tolls	*Base Time Value Weekend Tolls*	*Low Time Value No Weekend Tolls*	*Base Time Value Weekend Tolls*
2009	$ 3.5 M	$ 5.6 M	$ 4.3 M	$ 6.7 M
2010	$ 3.6 M	$ 5.7 M	$ 4.4 M	$ 7.0 M
2011	$ 3.6 M	$ 5.7 M	$ 4.6 M	$ 7.2 M
2012	$ 3.7 M	$ 5.8 M	$ 4.7 M	$ 7.5 M
2013	$ 3.7 M	$ 5.8 M	$ 4.9 M	$ 7.8 M
2014	$ 3.7 M	$ 5.9 M	$ 5.1 M	$ 8.1 M
2015	$ 3.8 M	$ 5.9 M	$ 5.3 M	$ 8.4 M
2016	$ 3.8 M	$ 6.0 M	$ 5.5 M	$ 8.7 M
2017	$ 3.8 M	$ 6.1 M	$ 5.7 M	$ 9.1 M
2018	$ 3.9 M	$ 6.1 M	$ 6.0 M	$ 9.4 M
2019	$ 3.9 M	$ 6.2 M	$ 6.3 M	$ 9.9 M
2020	$ 4.0 M	$ 6.2 M	$ 6.6 M	$ 10.4 M
2021	$ 4.0 M	$ 6.3 M	$ 6.8 M	$ 10.7 M
2022	$ 4.1 M	$ 6.4 M	$ 7.0 M	$ 11.1 M
2023	$ 4.1 M	$ 6.4 M	$ 7.3 M	$ 11.5 M
2024	$ 4.1 M	$ 6.5 M	$ 7.6 M	$ 11.9 M
2025	$ 4.2 M	$ 6.6 M	$ 7.8 M	$ 12.3 M
2026	$ 4.2 M	$ 6.6 M	$ 8.1 M	$ 12.8 M
2027	$ 4.3 M	$ 6.7 M	$ 8.4 M	$ 13.3 M
2028	$ 4.3 M	$ 6.8 M	$ 8.8 M	$ 13.8 M
2029	$ 4.4 M	$ 6.9 M	$ 9.1 M	$ 14.3 M
2030	$ 4.4 M	$ 6.9 M	$ 9.4 M	$ 14.8 M

Figure 2
Baseline Alternative Toll Revenue Range in Inflated Dollars



A discussion of the capital investment "purchasing power" of this revenue stream follows the presentation of the traffic and revenue projections for Alternative D.

Alternative D Traffic Projections

In contrast to the revenue projections prepared for the Baseline "No-Action" Alternative, which represent the tolling of the existing AWV, those for Alternative D consider the tolling of the most comprehensive of the "build" replacement alternatives. Revenue projections for the other build alternatives, to the extent that they offer similar access, would likely fall somewhere between those for the Baseline Alternative and Alternative D.

Alternative D represents a grade-separated replacement to the AWV comprised primarily of a cut and cover tunnel, and would differ from what exists today in the following ways:

- It would provide improved access to mid-downtown Seattle.
- Although it would include the same number of lanes, it would be designed to current, higher standards, facilitating smoother operation at slightly higher speeds, and as a result, provides a slightly higher vehicle capacity.
- It would extend the facility length by nine-tenths of a mile, adding about 23% to the current facility's 4.02 miles within the defined project area.

Traffic volumes were modeled for Alternative D with and without optimal tolls for all daily time periods for the future year of 2030. An assignment was then run using the base year model to simulate only the Alternative D network improvements in the present so as to have two points from which to interpolate intermediate years. Table A- 4 in the Appendix provides the resulting annual average daily traffic volumes, toll diversion rates, and time period V/C ratios, by model link, for 1998, 2009, and 2030. Toll diversion rates are slightly higher for Alternative D than for the Baseline Alternative.

Optimal toll rates were then estimated from the without toll traffic volumes and V/C ratios by time period for 1998 and 2030. Table 6 presents these rates — expressed as the monetary amount per mile in year 2000 dollars — for various time periods and travel directions, under both the low value of time of $7.89 per hour and the base value of time of $11.83 per hour. Once again, optimal toll rates for night-time hours proved to be insignificant due to low demand levels and were consequently set to zero.

Table 6
Average Optimal Toll Rates for Alternative D (2000 Dollars)

Toll Rates per Mile — Alt. D	Base Value of Time		Low Value of Time	
	1998	2030	1998	2030
Off-Peak (Midday) Toll Rate	$0.03	$0.04	$0.02	$0.02
Peak Period/Peak Direction Toll Rate	$0.10	$0.12	$0.06	$0.08
Peak Period/Reverse Direction Toll Rate	$0.03	$0.07	$0.02	$0.05
Night Toll Rate	$0.00	$0.00	$0.00	$0.00

Note that the optimal toll rates for Alternative D are in several cases marginally lower than those for the Baseline Alternative shown in Table 2. Several attributes that were coded into the model for Alternative D contribute to this somewhat interesting result. First, the higher design standards allow for slightly higher operating speeds. This is complemented by better connections at the north and south endpoints, and thus, reduced bottlenecks. Both of these factors lead to marginal increases in capacity, which lowers the modeled V/C ratios via the denominator, pushing optimal toll rates downward. In reaching equilibrium, the model also takes into account that slightly higher speeds and capacities will attract additional users, potentially increasing V/C ratios via the numerator, pushing optimal toll rates upward. However, because Alternative D has the slight disincentive of a longer travel distance than the existing facility, the resulting increase in users is not fully commensurate with the improvement in operating conditions (greater capacity and speed). In fact, although Alternative D attracts more users, its longer travel distance offsets its higher average operating speed, such that there are essentially no time savings, and potentially a small time cost, compared with the No-Action Alternative. All of these factors contribute to slightly lower V/C ratios for Alternative D as modeled, and in accordance with Figure 1 and Table 1, lower V/C ratios result in lower optimal toll rates.

Once again, the following revenue projections assume that the posted toll rates per mile are maintained at their optimal toll levels through both annual increases for inflation (affecting value of time) and rising demand (affecting the V/C ratio). Failure to increase toll rates to maintain optimality for either of these two effects could lead to the occurrence of congestion on the AWV replacement facility, which will reduce throughput and negate part of the reason why tolls are imposed in the first place.

Taking into account the implementation of tolling only after a new facility is completed (no sooner than 2009), Table 7 presents the proposed toll rate schedule for Alternative D using the base value of time of $11.83 per hour. As before, values of time and toll rates by year are expressed in both real terms (denominated by constant year 2000 dollars), as well as in inflated (year of collection) dollars for purposes of estimating revenue. Table A- 2 in the Appendix presents this same toll rate schedule for the low value of time of $7.89 per hour.

Alternative D exhibits more substantial growth in the peak period, reverse direction toll rate than for the peak direction toll rate for the same reasons as the Baseline Alternative.

Table 7
Toll Rate per Mile Schedule — Alternative D
(Constant and Inflated Dollars — Base Value of Time)

Year	Constant Year 2000 Dollars				Inflated (Year of Expenditure) Dollars			
	Base Value of Time ($ / hr)	Peak Periods / Peak Direction	Peak Periods / Reverse Direction	Midday/ Evening & Weekend Both Dir	Base Value of Time ($ / hr)	Peak Periods / Peak Direction	Peak Periods / Reverse Direction	Midday & Weekend Both Directions
1998	$11.83	$0.10	$0.03	$0.03	$11.34	$0.09	$0.03	$0.03
1999	$11.83	$0.10	$0.03	$0.03	$11.53	$0.10	$0.03	$0.03
2000	$11.83	$0.10	$0.04	$0.03	$11.83	$0.10	$0.04	$0.03
2001	$11.83	$0.10	$0.04	$0.03	$12.05	$0.10	$0.04	$0.03
2002	$11.83	$0.10	$0.04	$0.03	$12.17	$0.10	$0.04	$0.03
2003	$11.83	$0.10	$0.04	$0.03	$12.43	$0.10	$0.04	$0.03
2004	$11.83	$0.10	$0.04	$0.03	$12.72	$0.11	$0.04	$0.03
2005	$11.83	$0.10	$0.04	$0.03	$13.00	$0.11	$0.04	$0.03
2006	$11.83	$0.10	$0.04	$0.03	$13.29	$0.11	$0.05	$0.03
2007	$11.83	$0.10	$0.04	$0.03	$13.59	$0.12	$0.05	$0.03
2008	$11.83	$0.10	$0.04	$0.03	$13.89	$0.12	$0.05	$0.04
2009	$11.83	$0.10	$0.04	$0.03	$14.20	$0.12	$0.05	$0.04
2010	$11.83	$0.10	$0.04	$0.03	$14.53	$0.13	$0.05	$0.04
2011	$11.83	$0.10	$0.05	$0.03	$14.89	$0.13	$0.06	$0.04
2012	$11.83	$0.10	$0.05	$0.03	$15.30	$0.14	$0.06	$0.04
2013	$11.83	$0.11	$0.05	$0.03	$15.74	$0.14	$0.06	$0.04
2014	$11.83	$0.11	$0.05	$0.03	$16.18	$0.15	$0.07	$0.04
2015	$11.83	$0.11	$0.05	$0.03	$16.65	$0.15	$0.07	$0.04
2016	$11.83	$0.11	$0.05	$0.03	$17.14	$0.16	$0.07	$0.05
2017	$11.83	$0.11	$0.05	$0.03	$17.66	$0.16	$0.08	$0.05
2018	$11.83	$0.11	$0.05	$0.03	$18.25	$0.17	$0.08	$0.05
2019	$11.83	$0.11	$0.05	$0.03	$18.89	$0.17	$0.09	$0.05
2020	$11.83	$0.11	$0.06	$0.03	$19.61	$0.18	$0.09	$0.05
2021	$11.83	$0.11	$0.06	$0.03	$20.09	$0.19	$0.10	$0.06
2022	$11.83	$0.11	$0.06	$0.03	$20.58	$0.19	$0.10	$0.06
2023	$11.83	$0.11	$0.06	$0.03	$21.10	$0.20	$0.11	$0.06
2024	$11.83	$0.11	$0.06	$0.03	$21.64	$0.21	$0.11	$0.06
2025	$11.83	$0.11	$0.06	$0.03	$22.19	$0.21	$0.12	$0.06
2026	$11.83	$0.11	$0.06	$0.03	$22.76	$0.22	$0.12	$0.07
2027	$11.83	$0.11	$0.07	$0.03	$23.36	$0.23	$0.13	$0.07
2028	$11.83	$0.11	$0.07	$0.03	$23.98	$0.23	$0.14	$0.07
2029	$11.83	$0.12	$0.07	$0.03	$24.63	$0.24	$0.14	$0.07
2030	$11.83	$0.12	$0.07	$0.04	$25.29	$0.25	$0.15	$0.08

Note: Toll operations not expected to commence prior to 2009

Table 8 presents the forecasted weekday and weekend traffic demand from the opening year through 2030, expressed as vehicle miles traveled (VMT). Daily VMT by year is shown for each direction, along with the subset of VMT that falls within the toll period. Note that with tolls applied for 15 hours per day, approximately 86% of weekday travel, and 77% of weekend travel would be subject to tolls.

In contrast to the Baseline, Alternative D shows 30% more VMT during the weekday tolling period. This is due to its slightly higher volumes attributable to the aforementioned access and operations improvements, and the 23% longer travel distance within the project area.

Table 8
Total & Tolled Daily Vehicle-Miles Traveled — Alternative D

Before ETC Non-Participation / Evasion Adjustments

	Weekday (24 hr)		*Weekday Tolled (15 hr)*		*Weekend (24 hr)*		*Weekend Tolled (15 hr)*	
Year	***NB***	***SB***	***NB***	***SB***	***NB***	***SB***	***NB***	***SB***
	100.0%	***100.0%***	***85.7%***	***85.7%***	***100.0%***	***100.0%***	***77.1%***	***77.1%***
2009	220,643	225,425	189,173	193,246	110,322	112,712	85,076	86,920
2010	221,778	226,416	190,079	194,070	110,889	113,208	85,514	87,302
2011	222,920	227,412	190,990	194,899	111,460	113,706	85,954	87,686
2012	224,068	228,413	191,906	195,732	112,034	114,206	86,397	88,072
2013	225,223	229,419	192,828	196,570	112,611	114,710	86,842	88,460
2014	226,385	230,431	193,754	197,412	113,193	115,215	87,290	88,850
2015	227,554	231,448	194,686	198,258	113,777	115,724	87,741	89,242
2016	228,730	232,470	195,623	199,108	114,365	116,235	88,194	89,636
2017	229,913	233,497	196,566	199,963	114,957	116,748	88,650	90,032
2018	231,103	234,529	197,513	200,822	115,552	117,265	89,109	90,430
2019	232,301	235,567	198,466	201,686	116,150	117,784	89,571	90,830
2020	233,505	236,610	199,425	202,554	116,753	118,305	90,035	91,233
2021	234,717	237,659	200,389	203,427	117,358	118,830	90,503	91,637
2022	235,936	238,713	201,358	204,304	117,968	119,357	90,973	92,044
2023	237,162	239,773	202,333	205,186	118,581	119,886	91,445	92,452
2024	238,396	240,838	203,314	206,072	119,198	120,419	91,921	92,863
2025	239,637	241,909	204,300	206,963	119,819	120,954	92,400	93,276
2026	240,886	242,985	205,292	207,859	120,443	121,492	92,881	93,691
2027	242,142	244,066	206,289	208,759	121,071	122,033	93,366	94,108
2028	243,406	245,154	207,293	209,664	121,703	122,577	93,853	94,527
2029	244,677	246,247	208,301	210,574	122,339	123,123	94,343	94,948
2030	245,956	247,346	209,316	211,488	122,978	123,673	94,836	95,372

Note: Toll operations not expected to commence prior to 2009

Appendix Table A- 6 provides additional VMT demand information for Alternative D further divided by the three weekday toll time periods (AM peak, midday and PM peak) as well as night hours.

Alternative D Toll Revenue Forecasts

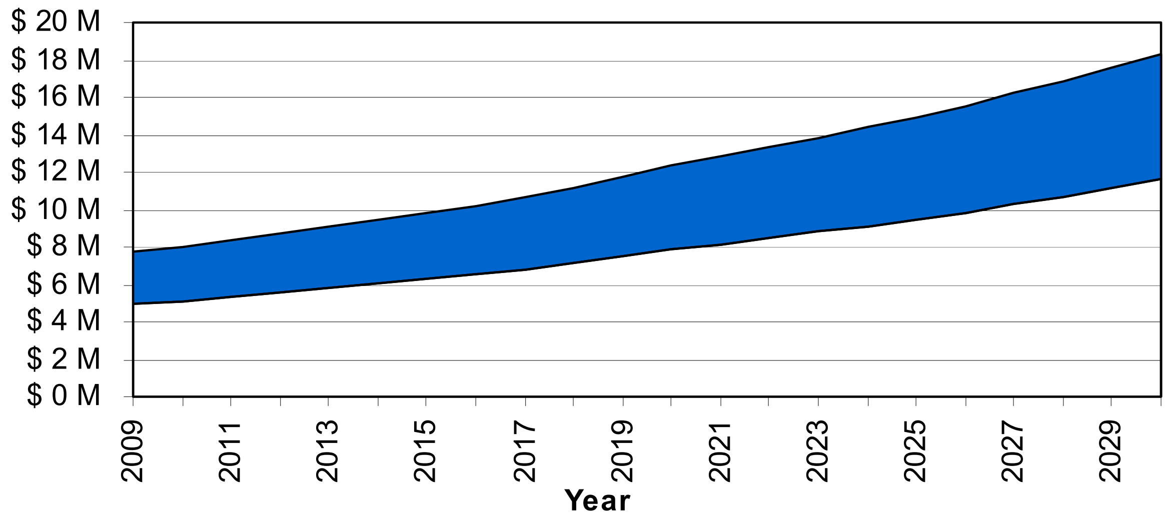
As with the Baseline Alternative, Alternative D's optimal toll rates can be readily applied to the VMT-based traffic forecasts to generate daily and annual revenue forecasts. A range of revenue was again considered by varying the value of time underlying the optimal toll rate as well as excluding weekend toll revenues. The low end of the range employs the low value of time and excludes weekend toll revenue while the high end of the range applies the base value of time and adds in weekend revenue.

Gross revenue estimates calculated from the daily VMT data by toll period were adjusted upward to reflect the percentage of the traffic representing trucks paying higher tolls, and also adjusted downward to account for ETC evasion and/or vehicle transponder non-participation. Weekday and weekend/holiday daily revenue estimates were then annualized using appropriate factors. The resulting annual toll revenue forecast ranges for the Baseline Alternative in constant and inflated dollars are presented in Table 9. Figure 3 graphically presents the likely range of revenue in inflated or year of collection dollars.

Table 9
Annual Toll Revenue Ranges — Alternative D

Year	Constant Year 2000 Dollars		Inflated (Year of Collection) Dollars	
	Low Time Value No Weekend Tolls	Base Time Value Weekend Tolls	Low Time Value No Weekend Tolls	Base Time Value Weekend Tolls
2009	$ 4.1 M	$ 6.5 M	$ 5.0 M	$ 7.8 M
2010	$ 4.2 M	$ 6.5 M	$ 5.1 M	$ 8.0 M
2011	$ 4.2 M	$ 6.6 M	$ 5.3 M	$ 8.3 M
2012	$ 4.3 M	$ 6.7 M	$ 5.6 M	$ 8.7 M
2013	$ 4.3 M	$ 6.8 M	$ 5.8 M	$ 9.0 M
2014	$ 4.4 M	$ 6.9 M	$ 6.0 M	$ 9.4 M
2015	$ 4.5 M	$ 7.0 M	$ 6.3 M	$ 9.8 M
2016	$ 4.5 M	$ 7.1 M	$ 6.5 M	$ 10.2 M
2017	$ 4.6 M	$ 7.2 M	$ 6.8 M	$ 10.7 M
2018	$ 4.6 M	$ 7.3 M	$ 7.1 M	$ 11.2 M
2019	$ 4.7 M	$ 7.4 M	$ 7.5 M	$ 11.7 M
2020	$ 4.7 M	$ 7.4 M	$ 7.9 M	$ 12.3 M
2021	$ 4.8 M	$ 7.6 M	$ 8.2 M	$ 12.8 M
2022	$ 4.9 M	$ 7.7 M	$ 8.5 M	$ 13.3 M
2023	$ 4.9 M	$ 7.8 M	$ 8.8 M	$ 13.8 M
2024	$ 5.0 M	$ 7.9 M	$ 9.1 M	$ 14.4 M
2025	$ 5.1 M	$ 8.0 M	$ 9.5 M	$ 15.0 M
2026	$ 5.1 M	$ 8.1 M	$ 9.9 M	$ 15.5 M
2027	$ 5.2 M	$ 8.2 M	$ 10.3 M	$ 16.2 M
2028	$ 5.3 M	$ 8.3 M	$ 10.7 M	$ 16.8 M
2029	$ 5.3 M	$ 8.4 M	$ 11.1 M	$ 17.5 M
2030	$ 5.4 M	$ 8.5 M	$ 11.6 M	$ 18.3 M

Figure 3
Alternative D Toll Revenue Range in Inflated Dollars



Additional detailed revenue information for build Alternative D can be found in Appendix Table A- 9 expressed in constant dollars, and in Table A- 10 expressed in inflated (year of collection) dollars.

Despite lower optimal toll rates per mile, higher traffic volumes over the longer travel distance yield a revenue range under Alternative D that exceeds that of the Baseline Alternative. In fact, over time, Alternative D provides more room for demand growth, reflected in V/C ratios and optimal toll rates that escalate by larger percentage amounts over the forecast horizon.

Annual Toll Revenue Purchasing Power

A revenue projection raises the question of how much will the annual cash flow buy, in terms of capital investment, via bond debt financing. Several factors would influence this, including the duration of construction; prevailing interest rates; debt structure, duration and issuance costs; and required debt service coverage, among others. While a detailed financial analysis is beyond the scope of this study, it is possible to gauge the approximate amount that could be leveraged through the sale of tax-exempt municipal bonds for each $1 million in toll revenues.

Under a reasonable set of assumptions based upon current market conditions, each $1 million in annual toll revenues available for debt repayment could purchase on the order of $7 to $10 million in capital investment, plus another $1 to 2 million to cover a few years of capitalized debt service during construction. Note that despite revenue growth over time, the financial markets will require that initial operating revenues available for debt service more than cover actual debt service costs, the difference being a cushion from which the debt service coverage ratio is specified. Eventually, excess revenues may be redirected to other uses, including early debt retirement.

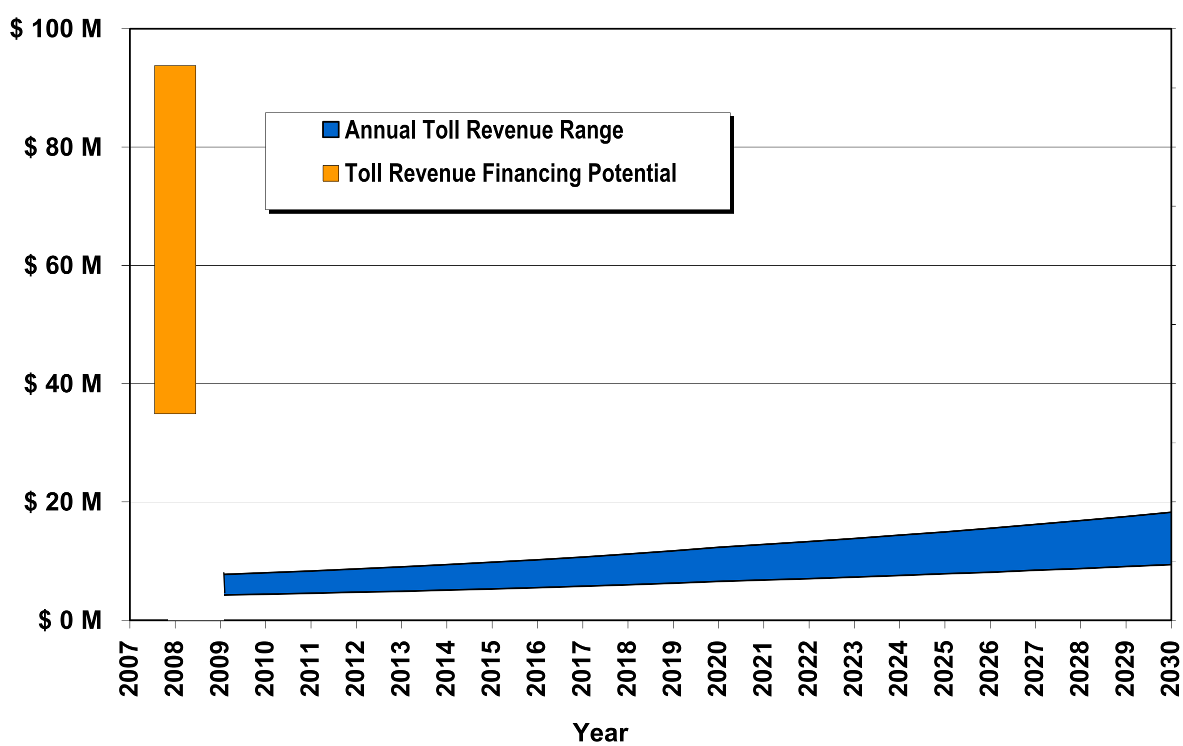
A key consideration here is that toll revenue would not be available until the new facility is opened, but borrowing will need to commence with or before construction. This in turn requires that debt service costs during construction — interest costs at a minimum, and possibly principal repayments, depending on how the debt is structured — must be capitalized as part of the construction investment cost. The delay between debt issuance and receipt of operating revenues encumbers some of the revenue stream to cover the additional project costs for debt service during construction, leaving less for pure construction activities.

For example, looking at the high end estimate of $10 million capital investment per $1 million in toll revenue, the $10 million excludes any capitalized debt service costs, which could add up to another $1.5 to $2 million. Thus, an alternative interpretation is that $1 million in toll revenues could finance upwards of $12 million in project costs, including capitalized debt service.

Assuming commencement of toll operations in 2009, the purchasing power reflected by the full range of projected revenue herein (across both alternatives) suggest a lower bound of $35 million and an upper bound of $95 million in project costs, including capitalized debt service.

Figure 4 depicts the capital investment bounds that could be financed via the overall annual revenue range. In this case, the overall annual revenue range is computed across both alternatives, the base and low values of time, and with and without weekend tolls.

Figure 4
Overall Toll Revenue Range and Project Financing Potential



TOLL EXPERIENCE IN WASHINGTON STATE AND ELSEWHERE

Though Washington State lacks recent experience with toll facilities, it is perhaps useful to examine how previous pricing influenced travel demand to help put some context to the Alaskan Way Viaduct toll demand modeling results.[10] A brief analysis of this follows.

In addition, a recent phone survey of Puget Sound area travelers conducted as part of the WSDOT Managed Lanes Study provides some insight into the public's views on tolling. Results across all respondents and trip types indicate there is strong public support for managing traffic demand to prevent congestion. For pricing as the management tool, a bit more than 40% of people indicated a willingness to pay tolls for a faster trip. When queried about tolling the I-5 Express Lanes, about 50% of respondents supported varying toll rates by time of day to manage traffic flow.

Similarly, it is illustrative to compare the proposed toll rates per mile on the AWV to other North American facilities, recognizing that each facility has unique and widely varying historical per unit construction costs and ongoing operating objectives.

Demand Effects of Removing Tolls on Washington State Toll Bridges

To put into perspective the roughly 15% toll diversion to other routes expected for the Alaskan Way Viaduct or its replacement facility, traffic data was analyzed before and after removal of tolls on the two most recent such facilities in Washington State.

Hood Canal Bridge Experience

The $2.00 toll on the Hood Canal Bridge was removed on August 29, 1985. In 1984, annual average daily traffic (AADT) was 5,982 vehicles with the toll. In 1986, AADT jumped 38% to 8,253 vehicles in the first full year without the toll. This seems to indicate that in the year before the toll was eliminated, it was causing a diversion of 27.5% of would-be vehicle trips to either be made using alternative routes, or more likely in this case, to not be made at all.

SR-520 Floating Bridge Experience

The Governor Albert Rosellini Evergreen Point Floating Bridge (SR-520) opened in August 1963 with a $0.35 toll each way. The toll rate was set to pay debt service costs for construction bonds. In today's dollars, the $0.35 toll in each direction is equivalent to $1.70. With projected inflation, this corresponds to over $2.00 in 2009, the assumed earliest year of opening for a replacement facility.

[10] WSDOT recently received approval to implement tolls on SR-16's Tacoma Narrows Bridge at an initial rate of $3.00 per round-trip. WSDOT has substantial experience charging tolls for ferry service across Puget Sound.

The SR-520 bridge toll — still at $0.35 per direction — was removed in June 1979. At the time of removal, the real cost of the toll had declined considerably since the bridge opening to about $0.85 in today's dollars, or about $1.00 in year 2009 dollars.

In 1978, the last full year of toll operations, AADT numbered 60,452 vehicles, versus 56,752 on the unpriced parallel I-90 Floating Bridge. By 1980, AADT on SR-520 had jumped 19.3% to 72,139 while traffic on I-90 fell by 7.9% to 52,283. These results suggest that toll diversion on SR-520 was approximately 16.2%, with over one-third of the toll-inhibited vehicle trips diverted to I-90, and the remainder either north around the lake or not at all.

Comparison Information for Selected North American Toll Facilities

The following provides some comparable information for selected toll facilities in U.S. and Canada for purposes of illustrating the context of implementing tolls on the AWV. While the list is by no means comprehensive, it does indicate that proposed range of toll rates for the AWV is within those found on other facilities, particularly those in California, which have similar operating objectives.

SR-91 Express Lanes, Orange County, CA

- Year Opened: 1995
- Principal operating objective: Revenue maximization
- Length, Type & Location: 10 miles, located in the median of the SR-91 freeway; extends east from the SR-91/SR-55 freeway interchange to the Riverside/Orange County line. Adjacent to free facility
- Access: end-points only
- Minimum toll segment: 10 miles
- HOV rate: 50% discount for HOV 3+
- Trucks: No
- Tolling Mechanism; 100% ETC
- Toll Unit: Entire facility distance
- Toll Range: $1.00 to $4.75 (highest tolls eastbound 4 to 6 pm)
  - AM peak: $1.90 to $3.60 (peak direction)
  - PM peak: $3.50 to $4.75 (peak direction)
- Toll Rate per Mile: $0.10 to $0.48
- Notes: Sharp directionality. Tolls vary by time of day.

I-15 FasTrak, San Diego, CA

- Year Opened: 1996

- Principal operating objective: Throughput target
- Length, Type & Location: 8 miles as a two-lane, reversible facility in the median of I-15 in San Diego, California. Barriers separate the express lanes from the adjacent free regular traffic lanes.
- Access: end-points only
- Minimum toll segment: 8 miles
- HOV rate: Free
- Trucks: No (verify)
- Tolling Mechanism: 100% ETC
- Toll Unit: Entire facility distance
- Toll Range: $0.75 to $4.00 (though escalate up to $8.00 during an incident)
  - AM peak: $0.75 to $4.00 (peak direction)
  - PM peak: $1.00 to $4.00 (peak direction)
- Toll per mile: $0.09 to $0.50
- Notes: Under severe congestion, tolls can be as high as 8.00. Toll revenues pay for operating costs and enforcement provided by the California Highway Patrol. This facility was converted from an underutilized HOV lane to a priced roadway for SOVs, and State law requires that any additional revenues be used to pay for transit. Tolls vary dynamically in relation to a published schedule.

Dulles Greenway, VA

- Year Opened: 1995
- Principal operating objective: Revenue maximization
- Length, Type & Location: Privately owned 14-mile toll road that connects Washington Dulles International Airport with Leesburg, Virginia. Provides alternate route to Route 7/28. Four lanes with reversible options.
- Access: 6 access points
- Minimum toll segment: 8 miles
- HOV rate: No
- Trucks: Yes (different rate)
- Tolling Mechanism: Credit card and ETC
- Toll Unit: flat rates charged between exits and/or plazas
- Toll Range: $0.50 to $2.00
  - Rate by distance, exits and main toll plaza
  - Lower rates on weekends

- Higher rates for 3+ axles ($1.00 to $4.00)
- Discount for Smart Tag
- Toll per mile: $0.14 (based on full length and main toll plaza)

Dulles Toll Road, VA

- Year Opened: 1984
- Principal operating objective: Revenue target?
- Length; 14 miles
- Location: The Dulles Toll Road (DTR) is an 8 lane (4 lanes in each direction) limited access highway approximately 14 miles in length, which is owned and operated by the Virginia Department of Transportation (VDOT).
- Access: 11 access/exits
- Minimum toll segment: 1 mile
- HOV rate: Free
- Trucks: Yes (different rate)
- Tolling Mechanism: 100% ETC
- Toll Unit: flat rates charged between exits and/or plazas
- Toll Range: $0.25 to $0.50
  - Extra cost per additional axle
- Toll per mile: $0.02 to $0.04

Harris County Toll Road , Houston TX

- Year Opened: 1987
- Principal operating objective: Revenue target (retirement of debt, O&M costs)
- Length, Type & Location: 83 mile tolled ring road around Houston, TX.
- Access: multiple access/exit points
- Minimum toll segment: 4 miles (based on a sample section)
- HOV rate: No
- Trucks: Yes (different rate)
- Tolling Mechanism: ETC, cash, tokens
- Toll Unit: flat rates charged between exits and/or plazas
- Toll Range: $0.25 to $1.00 ($2.00 for Ship bridge)
  - Based on distance/exit or plaza

- Extra cost per additional axle
- Discount for tokens or EZ Tag

- Toll per mile: $0.06 to $0.13 (varies by section depending on exit point)
- Notes: Sample section priced is Sam Houston Southwest

New Jersey Turnpike, NJ

- Year Opened: 1951
- Principal operating objective: Revenue target (retirement of debt, O&M costs)
- Length, Type & Location: 118 miles within the State of New Jersey, parts of which include dual tolled facilities in which trucks are prohibited on one of the two facilities.
- Access: multiple access/exit points
- Minimum toll segment: 1 mile
- HOV rate: No
- Trucks: Yes (different rate)
- Tolling Mechanism: ETC, coins, tokens
- Toll Unit: flat rates charged between exits and/or plazas
- Toll Range: $0.55 to $5.50 (distance based)
  - $0.45 to $4.60 off peak
  - Based on distance/exit or plaza
  - Extra cost for truck or bus
  - Discount for EZ Tag and weekend
- Toll per mile: $0.03 to $0.05 peak - $0.03 and $0.04 off peak

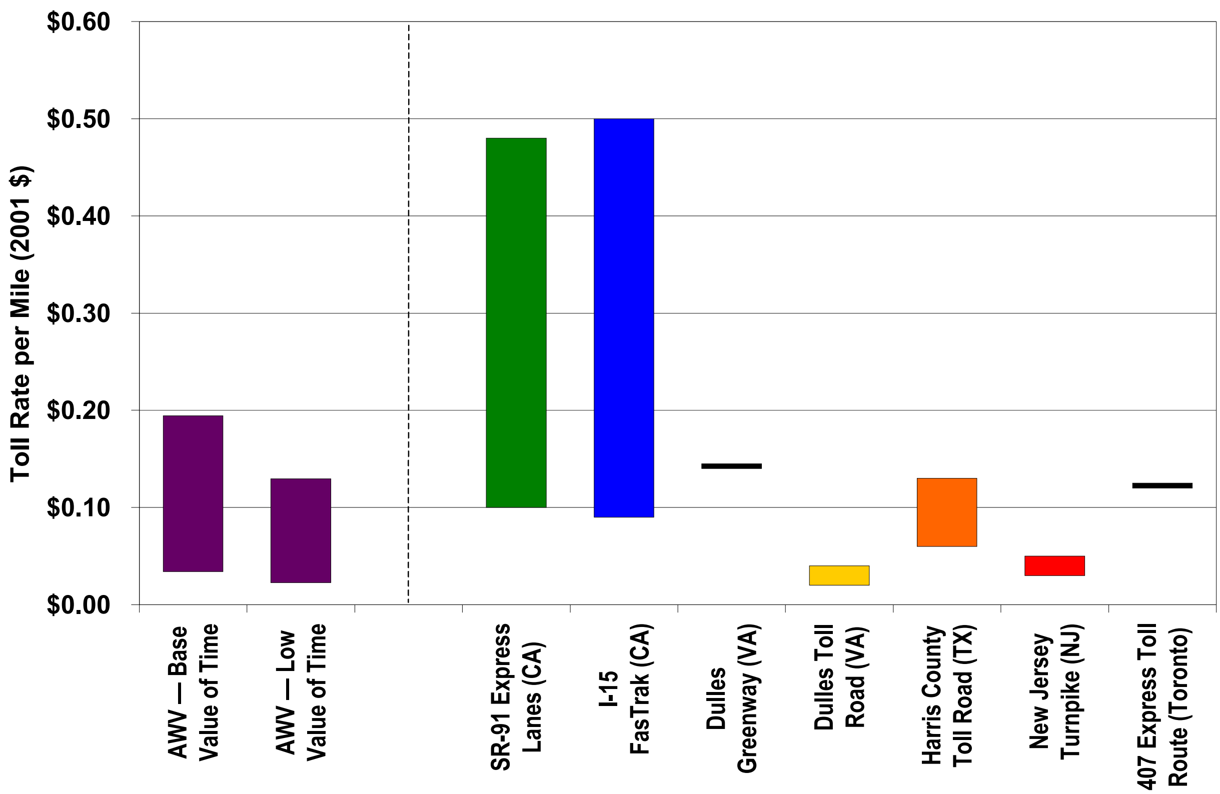
407 Express Toll Route (ETR), Toronto, Canada

- Year Opened: 1997
- Principal operating objective: Revenue maximization
- Length, Type & Location: 108 kilometers (68 miles) running east-west at the north edge of Toronto (from EW in the west to Highway 7 just east of Brock Road in the east).
- Minimum toll segment: approximately 5 km (3.1 mi)
- HOV rate: No
- Trucks: Yes (different rate)
- Tolling Mechanism: 100% ETC
- Toll unit: per kilometer between exits and/or plazas

- Toll Range: $0.12 US per mile
  - Higher fees for larger vehicles
- Note: Vehicles without transponder are billed via license plate recognition plus an administrative surcharge for processing. Large vehicles require a transponder.

Table 10 presents a comparison of the range of toll rates for the selected toll facilities to those proposed for the range of AWV alternatives in the opening year of 2009, *with all amounts shown in 2001 US dollars*. At only 4-5 miles in length, the AWV is by far the shortest of the other toll facilities listed above. Note also that several of these facilities have operating objectives that are most likely tied to revenue targets, such as debt service, which may result in a toll rate or time of day toll structure that is sub-optimal from the standpoint of economic efficiency.

Table 10
Comparison of Opening Year (2009) AWV Toll Rates with Selected North American Toll Road Rates in 2001 $



THE NEXT LEVEL: INVESTMENT GRADE TOLL REVENUE FORECASTS

By striking a balance between technical methods and resource constraints, the optimal toll estimates and resulting toll revenue forecasts presented herein represent "first cut" results. These results are intended to inform the consideration of implementing user fees on the AWV with the objective of identifying if tolls look promising enough to warrant further research.

Assuming that toll revenues look promising and are intended to serve as a primary source of funds from which to borrow against and cover debt service costs (e.g., the sale of revenue bonds), then the successful issuance of debt will likely require completion of a more thorough, "investment grade" toll traffic and revenue forecast study.

In a simplistic sense,"investment grade" revenue forecast is whatever set of assumptions, methods, and review procedures that are sufficiently conservative to instill the confidence of the bond rating agencies and financial markets. Specifically, a minimum "investment grade" rating from one or more rating agencies is necessary to achieve reasonable financing terms and cost-effectively sell toll revenue bonds.[11] Rating agencies such as Standard and Poor, Moodys and Fitch evaluate the revenue sources that would be dedicated to the repayment of bonds in order to rate the risk associated with a particular issuance. A proposed issuance that receives a rating is considered investment grade, and the better the rating, the more marketable the securities are and the lower the interest rate paid by the borrower, all else equal. Bonds that backed by revenue sources with sufficient uncertainty that they do not to get rated are known as sub-investment grade or "junk" bonds. Such bonds can be difficult to market, and result in very high interest costs as investors demand a premium return commensurate with the risks of default.

In order to obtain an investment grade rating, an independent third party must prepare a detailed traffic and revenue study that addresses all of the pertinent issues related to the toll revenue, including the elasticity of demand, demographic inputs (an independent view of this separate from the MPO), toll rates, operations and maintenance costs, etc.[12] In addition, investment grade forecasts tend to be distinguished from preliminary or planning grade results by their more rigorous and critical deliberation of assumptions, methods and review procedures at all stages. Finally, they typically result in a very thorough and professional report combined and in-person meeting with the rating agencies.

The actual assumptions, methods and review procedures for an investment grade study are not proscribed — in fact, they can vary across projects and be subject to considerable debate — rather it is the thorough consideration of risk variation, examination of inputs, validation tests, high standards of quality, and independent review at every step of the process that tend to characterize investment grade results. It should also be noted that investment grade results involve much more time consuming and costly efforts than do the initial planning level

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[11] Financial assistance via the federal Transportation Infrastructure Finance and Innovation Act (TIFIA) also requires investment grade traffic and revenue forecasts.

[12] In the U.S. tax-exempt bond market, there are currently only a few firms that the rating agencies are willing to rely upon for these forecasts

forecasts. However, if preliminary revenue forecasts suggest tolls could back revenue bonds amounting to a significant share of project funding (which is not likely to be the case for the AWV), then investment grade forecasts are warranted and will pay for themselves by conveying and reducing risks as well as facilitating and lowering the cost of project financing.

AWV Toll Revenue Considerations

For the AWV project area comprised of the greater Seattle region, more detailed market research regarding the behavioral nature and characteristics of potential road users, including their willingness to pay tolls, is needed to inform investment grade forecasts. Similarly, extensive travel demand modeling with better tools are required to apply the results of such research and better estimate toll elasticities of demand. It is likely that investment grade results would require a development of a state-of-the-art travel demand forecasting model, or further refinement and modifications to the existing PSRC regional travel demand model, in order to provide adequate capabilities to conduct detailed sensitivity analysis of various pricing and travel benefit combinations. Development of such a tool would require a variety of professionals with specialized skills and experience in which the following activities would likely be undertaken.

- **Detailed market research, most likely including a stated-preference survey (SPS) —** Market research would need to be conducted to identify and gauge travel market behavior, willingness to pay by trip purpose, frequency, and income range, preferences regarding time and travel benefit trade-offs, and socio-economic aspects. If an existing toll facility with similar characteristics to the proposed facility serves the same or similar markets, then it may be possible to use revealed preference and/or panel survey data of the existing toll facility user market to identify likely behavior for the proposed facility. However, since there are no other comparable toll facilities operating in the Puget Sound Region to allow for this, it is essential that some SPS research be undertaken. The resulting survey information is required to provide pertinent quantitative data on potential toll users' sensitivity with respect to willingness-to-pay, socio-economic characteristics, and other travel behavior attributes. SPS data may need to be pooled with other travel survey data already collected by PSRC.

- **Develop a toll mode choice model —** A toll mode choice model would need to be developed to allow more accurate simulation of travel behavior decisions with respect to pricing trade-offs in the travel forecasting process. This task will also involve using appropriate statistical techniques to estimate toll elasticities of demand for various market segments. Such a toll mode choice model has been recently developed for facilities in Houston and Orlando.

- **Integrate the toll mode choice model with the applicable travel demand model —** The toll mode choice model would then be implemented within either a newly developed travel demand forecasting model or a modified and refined PSRC model. This task may involve reliance on experience from toll operations in other regions across the country (e.g., Houston, Orlando, San Diego, etc.)

- **Model and estimate toll revenues and/or toll pricing structures —** Upon fully completing data collection and model development, toll revenue forecasts would be prepared and/or toll pricing structures would be estimated according to desired facility and network operating objectives (e.g., revenue maximization, economically efficient toll, throughput targets, etc.)

- **Independent Review and Documentation** — A panel of independent experts would be assembled to review and comment on the modeling process and forecast results, which may result in further refinements and process iteration to refine the estimates. A technical report would then be prepared to document above efforts, methodology and results in such a manner as to convey the level of conservatism and risks in the results and inform experts in the finance industry.

A key product of this process would be reliable estimates for the toll elasticity of demand over a range of toll rates, trip purposes, and user demographics. This would facilitate the development of an optimum pricing structure to serve the real world operating objective(s), as well as allow for sensitivity analyses testing of different pricing schemes.

KEY FINDINGS

- **There is sufficient travel demand and congestion in the Alaskan Way Viaduct corridor to warrant the application of congestion pricing via tolls. At the same time, the relatively short distance combined with the existence of several substitute parallel routes and a lack of peak period reverse direction and off-peak period demand limits the ultimate revenue potential that could be achieved by creating a more extended north-south urban corridor.**
  - Moreover, the success of implementing pricing on any single roadway, including the AWV, will likely be enhanced to the extent that other facilities within the regional highway system adopt pricing management techniques and integrated electronic payment methods. In any event, tolling the AWV will cause some diversion to City streets and I-5, particularly in the absence of a system-wide approach to pricing.
  - The physical needs for electronic tolling and/or cash payment toll collection have not been analyzed herein. However, there will likely be some significant physical and geographical challenges to implementing a cash payment toll collection option, particularly with multiple access and egress points in both travel directions.
- **For the Alaskan Way Viaduct or its replacement, application of the economically efficient or optimal per-mile toll rates using only electronic toll collection can be expected to generate gross annual revenue within the range of $4.3 to 7.8 million in the opening year of 2009.**
  - This estimated range excludes probable demand ramp-up effects that would occur during the initial months of operation. Actual revenue will depend on users' values of time as indicative of willingness to pay, and the time periods for which tolls are to be charged. Demand and gross revenue would be approximately 10% higher with a delay-free cash payment method, but manual toll collection congestion impacts and costs may offset much of the additional revenue.
- **The optimal toll rates seek to minimize overall network travel times. These toll rates are likely to be less than those that would maximize revenue; however, the appropriate research and tools for determining the revenue maximizing tolls do not currently exist. Nonetheless, the revenue maximizing toll structure would likely result in additional diversion and, thus, greater social delay costs due to increased congestion on unpriced facilities.**
- **Each $1 million of annual toll revenue, net of any operating costs, could leverage approximately $7-10 million of capital investment, plus another $1-2 million toward a few years of capitalized debt service costs during construction, via the sale of municipal revenue bonds or similar debt instruments.**
  - For the AWV replacement, the range of projected toll revenue equates to a range capital investment purchasing power with a lower bound of $35 million and an upper bound of $95 million in project costs, including capitalized debt service.
  - Exact amounts would depend on debt service coverage requirements, issuance costs, debt terms and duration, and the duration of construction, among other variables.

- **Toll revenue under Alternative D in 2009 exceeds that of the existing facility by 15%, escalating to 23% by 2030. This is a function of the longer travel distance of Alternative D combined with similar time savings due to higher design standards. Other build alternatives with similar access points would likely generate toll revenue between these two endpoints.**
  - Design improvements of the build alternatives lead to marginally improved capacity, operating efficiency, and thus, higher demand. This is somewhat offset by longer travel distances, and overall, the build alternatives are likely to result in per-mile toll rates similar to those for the existing facility. However, certain build alternatives may yield somewhat higher revenues, due to the fact that tolls are charged over longer travel distances and for slightly higher traffic volumes.
  - If the proposed toll facility became part of a larger limited access north-south corridor connecting in with SR-509 in the south and I-5 in the north, then the resulting benefits, demand levels, and thus, toll revenue could be significantly higher.
- **In opening year 2009, the maximum one-way optimal toll charge projected for travel from end-to-end, in the peak direction during peak periods, would be about 50¢ for Alternative D.**
  - The true toll rate depends on the actual value of time or willingness to pay for delay reduction exhibited by the travel market, and the physical characteristics of the toll facility in terms of distance, design standards and access/connection points.
  - The revenue maximizing toll could be somewhat higher than the economically efficient toll presented herein. However, higher toll rates would cause more diversion to I-5 and city streets, and may not minimize overall network travel times.
- **The optimal toll rates will need to increase periodically due to both inflation and growing travel demand, if the roadway is to be managed to yield economically efficient network traffic levels to prevent congestion.**
  - Regular toll increases will require that the operating objectives and management policies of the facility be well established and clearly communicated to the public and policy-makers.
  - Toll diversion to other routes, modes, time of day as well as trip chaining and elimination is expected to average from 13% to 17% across alternatives and analysis years. Localized diversion between various access points may vary outside of this range.

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Table A- 1
Toll Rate per Mile Schedule for the Baseline "No-Action" Alternative
(Constant and Inflated Dollars — Low Value of Time)

Year	Constant Year 2000 Dollars				Inflated (Year of Expenditure) Dollars			
	Low Value of Time ($ / hr)	Peak Periods / Peak Direction	Peak Periods / Reverse Direction	Midday/ Evening & Weekend Both Dir	Low Value of Time ($ / hr)	Peak Periods / Peak Direction	Peak Periods / Reverse Direction	Midday & Weekend Both Directions
1998	$7.89	$0.07	$0.02	$0.02	$7.56	$0.07	$0.02	$0.02
1999	$7.89	$0.07	$0.02	$0.02	$7.68	$0.07	$0.02	$0.02
2000	$7.89	$0.07	$0.03	$0.02	$7.89	$0.07	$0.03	$0.02
2001	$7.89	$0.07	$0.03	$0.02	$8.04	$0.08	$0.03	$0.02
2002	$7.89	$0.07	$0.03	$0.02	$8.11	$0.08	$0.03	$0.02
2003	$7.89	$0.08	$0.03	$0.02	$8.29	$0.08	$0.03	$0.02
2004	$7.89	$0.08	$0.03	$0.02	$8.48	$0.08	$0.03	$0.02
2005	$7.89	$0.08	$0.03	$0.02	$8.67	$0.08	$0.03	$0.02
2006	$7.89	$0.08	$0.03	$0.02	$8.86	$0.09	$0.03	$0.03
2007	$7.89	$0.08	$0.03	$0.02	$9.06	$0.09	$0.03	$0.03
2008	$7.89	$0.08	$0.03	$0.02	$9.26	$0.09	$0.03	$0.03
2009	$7.89	$0.08	$0.03	$0.02	$9.47	$0.09	$0.04	$0.03
2010	$7.89	$0.08	$0.03	$0.02	$9.69	$0.10	$0.04	$0.03
2011	$7.89	$0.08	$0.03	$0.02	$9.93	$0.10	$0.04	$0.03
2012	$7.89	$0.08	$0.03	$0.02	$10.20	$0.10	$0.04	$0.03
2013	$7.89	$0.08	$0.03	$0.02	$10.49	$0.11	$0.04	$0.03
2014	$7.89	$0.08	$0.03	$0.02	$10.79	$0.11	$0.04	$0.03
2015	$7.89	$0.08	$0.03	$0.02	$11.10	$0.12	$0.05	$0.03
2016	$7.89	$0.08	$0.03	$0.02	$11.42	$0.12	$0.05	$0.03
2017	$7.89	$0.08	$0.03	$0.02	$11.77	$0.13	$0.05	$0.03
2018	$7.89	$0.08	$0.03	$0.02	$12.17	$0.13	$0.05	$0.04
2019	$7.89	$0.09	$0.04	$0.02	$12.60	$0.14	$0.06	$0.04
2020	$7.89	$0.09	$0.04	$0.02	$13.07	$0.14	$0.06	$0.04
2021	$7.89	$0.09	$0.04	$0.02	$13.39	$0.15	$0.06	$0.04
2022	$7.89	$0.09	$0.04	$0.02	$13.72	$0.15	$0.06	$0.04
2023	$7.89	$0.09	$0.04	$0.02	$14.07	$0.16	$0.07	$0.04
2024	$7.89	$0.09	$0.04	$0.02	$14.43	$0.16	$0.07	$0.04
2025	$7.89	$0.09	$0.04	$0.02	$14.79	$0.17	$0.07	$0.04
2026	$7.89	$0.09	$0.04	$0.02	$15.17	$0.17	$0.08	$0.04
2027	$7.89	$0.09	$0.04	$0.02	$15.57	$0.18	$0.08	$0.04
2028	$7.89	$0.09	$0.04	$0.02	$15.99	$0.19	$0.08	$0.05
2029	$7.89	$0.09	$0.04	$0.02	$16.42	$0.19	$0.09	$0.05
2030	$7.89	$0.09	$0.04	$0.02	$16.86	$0.20	$0.09	$0.05

Note: Toll operations not expected to commence prior to 2009

Table A- 2
Toll Rate per Mile Schedule for Alternative D
(Constant and Inflated Dollars — Low Value of Time)

Year	Constant Year 2000 Dollars				Inflated (Year of Expenditure) Dollars			
	Low Value of Time ($ / hr)	Peak Periods / Peak Direction	Peak Periods / Reverse Direction	Midday/ Evening & Weekend Both Dir	Low Value of Time ($ / hr)	Peak Periods / Peak Direction	Peak Periods / Reverse Direction	Midday & Weekend Both Directions
1998	$7.89	$0.06	$0.02	$0.02	$7.56	$0.06	$0.02	$0.02
1999	$7.89	$0.07	$0.02	$0.02	$7.68	$0.06	$0.02	$0.02
2000	$7.89	$0.07	$0.02	$0.02	$7.89	$0.07	$0.02	$0.02
2001	$7.89	$0.07	$0.02	$0.02	$8.04	$0.07	$0.02	$0.02
2002	$7.89	$0.07	$0.02	$0.02	$8.11	$0.07	$0.03	$0.02
2003	$7.89	$0.07	$0.03	$0.02	$8.29	$0.07	$0.03	$0.02
2004	$7.89	$0.07	$0.03	$0.02	$8.48	$0.07	$0.03	$0.02
2005	$7.89	$0.07	$0.03	$0.02	$8.67	$0.07	$0.03	$0.02
2006	$7.89	$0.07	$0.03	$0.02	$8.86	$0.08	$0.03	$0.02
2007	$7.89	$0.07	$0.03	$0.02	$9.06	$0.08	$0.03	$0.02
2008	$7.89	$0.07	$0.03	$0.02	$9.26	$0.08	$0.03	$0.02
2009	$7.89	$0.07	$0.03	$0.02	$9.47	$0.08	$0.03	$0.02
2010	$7.89	$0.07	$0.03	$0.02	$9.69	$0.08	$0.04	$0.03
2011	$7.89	$0.07	$0.03	$0.02	$9.93	$0.09	$0.04	$0.03
2012	$7.89	$0.07	$0.03	$0.02	$10.20	$0.09	$0.04	$0.03
2013	$7.89	$0.07	$0.03	$0.02	$10.49	$0.09	$0.04	$0.03
2014	$7.89	$0.07	$0.03	$0.02	$10.79	$0.10	$0.04	$0.03
2015	$7.89	$0.07	$0.03	$0.02	$11.10	$0.10	$0.05	$0.03
2016	$7.89	$0.07	$0.03	$0.02	$11.42	$0.10	$0.05	$0.03
2017	$7.89	$0.07	$0.03	$0.02	$11.77	$0.11	$0.05	$0.03
2018	$7.89	$0.07	$0.04	$0.02	$12.17	$0.11	$0.05	$0.03
2019	$7.89	$0.07	$0.04	$0.02	$12.60	$0.12	$0.06	$0.03
2020	$7.89	$0.07	$0.04	$0.02	$13.07	$0.12	$0.06	$0.04
2021	$7.89	$0.07	$0.04	$0.02	$13.39	$0.12	$0.06	$0.04
2022	$7.89	$0.07	$0.04	$0.02	$13.72	$0.13	$0.07	$0.04
2023	$7.89	$0.07	$0.04	$0.02	$14.07	$0.13	$0.07	$0.04
2024	$7.89	$0.07	$0.04	$0.02	$14.43	$0.14	$0.07	$0.04
2025	$7.89	$0.08	$0.04	$0.02	$14.79	$0.14	$0.08	$0.04
2026	$7.89	$0.08	$0.04	$0.02	$15.17	$0.15	$0.08	$0.04
2027	$7.89	$0.08	$0.04	$0.02	$15.57	$0.15	$0.09	$0.05
2028	$7.89	$0.08	$0.04	$0.02	$15.99	$0.16	$0.09	$0.05
2029	$7.89	$0.08	$0.05	$0.02	$16.42	$0.16	$0.09	$0.05
2030	$7.89	$0.08	$0.05	$0.02	$16.86	$0.17	$0.10	$0.05

Note: Toll operations not expected to commence prior to 2009

Table A- 3
Applied Weekday Model Volumes and V/C Ratios by Period — Baseline Alternative

Link Distance (mi.)	Description	Daily Volumes Without Tolls 1998	2009	2030	Daily Volumes With Tolls (Excl. ETC Adjustments) 1998	2009	2030	Diversion Due to Tolling 1998	2009	2030
0.49	Spokane St/SR-99 Interchange	54,207	59,549	71,254	46,960	50,715	58,738	-13.4%	-14.8%	-17.6%
1.32	SR99 from Spokane St to S. Atlantic St	99,189	104,317	114,856	87,571	90,812	97,336	-11.7%	-12.9%	-15.3%
0.53	SR99 from S. Atlantic St to 1st Ave Ramps	99,189	104,317	114,856	87,571	90,812	97,336	-11.7%	-12.9%	-15.3%
0.20	AWV from 1st Ave Ramps to Yesler Way	130,527	135,779	146,401	115,813	118,699	124,408	-11.3%	-12.6%	-15.0%
0.14	AWV from Yesler Way to Columbia St	130,527	135,779	146,401	115,813	118,699	124,408	-11.3%	-12.6%	-15.0%
0.23	AWV from Columbia St to Seneca St	115,488	121,253	133,069	102,056	105,762	113,215	-11.6%	-12.8%	-14.9%
0.45	AWV from Seneca St to Western/Elliot Ave	102,038	108,217	121,073	89,256	93,343	101,673	-12.5%	-13.7%	-16.0%
0.06	SR 99-Elliot Ave/Western Ave I/C to Battery St Tunnel - A	78,280	84,347	97,266	66,115	70,057	78,249	-15.5%	-16.9%	-19.6%
0.21	SR 99-Elliot Ave/Western Ave I/C to Battery St Tunnel - B	60,574	66,411	79,164	48,892	52,552	60,316	-19.3%	-20.9%	-23.8%
0.29	Battery St tunnel	70,565	75,805	86,915	58,177	61,088	67,056	-17.6%	-19.4%	-22.8%
0.10	Battery St tunnel up to Denny Way Ramps	70,565	75,805	86,915	58,177	61,088	67,056	-17.6%	-19.4%	-22.8%
	Weighted Averages	**92,502**	**97,883**	**109,109**	**80,835**	**84,230**	**91,159**	**-12.6%**	**-13.9%**	**-16.5%**

Time Period & Direction	Wt. Average V/C Without Tolls 1998	2009	2030	Wt. Average V/C With Tolls (Excl. ETC Adjustments) 1998	2009	2030	Percent Change Due to Tolling 1998	2009	2030
AM / PM Peak Periods, Peak Direction	1.12	1.10	1.08	0.92	0.95	0.99	-17.3%	-14.3%	-8.2%
AM / PM Peak Periods, Non-Peak Direction	0.76	0.83	0.98	0.71	0.75	0.82	-5.6%	-9.3%	-16.0%
Midday Period, Southbound	0.57	0.60	0.67	0.70	0.70	0.70	22.4%	16.0%	4.7%
Midday Period, Northbound	0.54	0.57	0.63	0.70	0.64	0.55	30.5%	13.2%	-13.6%
Night Periods, Both Directions	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table A- 4
Applied Weekday Model Volumes and V/C Ratios by Period — Alternative D

Link Distance (mi.)	Description	Daily Volumes Without Tolls 1998	2009	2030	Daily Volumes With Tolls (Excl. ETC Adjustments) 1998	2009	2030	Diversion Due to Tolling 1998	2009	2030
0.49	Spokane St/SR-99 Interchange	55,734	61,825	75,363	50,708	55,519	66,005	-9.0%	-10.2%	-12.4%
1.32	SR99 from Spokane St to S. Atlantic St	129,973	136,484	149,833	111,770	115,982	124,471	-14.0%	-15.0%	-16.9%
0.53	SR99 from S. Atlantic St to 1st Ave Ramps	106,142	111,765	123,340	91,030	95,109	103,411	-14.2%	-14.9%	-16.2%
0.20	AWV from 1st Ave Ramps to Yesler Way	123,298	128,443	138,869	107,476	110,964	117,940	-12.8%	-13.6%	-15.1%
0.14	AWV from Yesler Way to Columbia St	82,943	114,900	104,749	69,957	97,953	84,711	-13.4%	-14.7%	-17.2%
0.23	AWV from Columbia St to Seneca St	96,418	102,901	116,512	82,629	86,843	95,494	-14.3%	-15.6%	-18.0%
0.22	AWV from Seneca St to Ramps north of Seneca St	82,943	89,872	104,749	69,957	74,713	84,711	-15.7%	-16.9%	-19.1%
0.45	AWV from Ramps north of Seneca St to Bell St	108,375	114,900	128,467	93,809	97,953	106,377	-13.4%	-14.7%	-17.2%
0.12	AWV from Bell St to Wall St	108,375	114,900	128,467	93,809	97,953	106,377	-13.4%	-14.7%	-17.2%
0.30	AWV from Wall St to Ramps from/to Elliot Ave	108,375	114,900	128,467	93,809	97,953	106,377	-13.4%	-14.7%	-17.2%
0.16	AWV from Ramps from/to Elliot Ave to Ist Ave	71,355	77,531	90,843	58,408	62,424	70,875	-18.1%	-19.5%	-22.0%
0.33	AWV from 1st Ave to Thomas St	71,355	77,531	90,843	58,408	62,424	70,875	-18.1%	-19.5%	-22.0%
0.30	AWV from Thomas St to Republican St	71,355	77,531	90,843	58,408	62,424	70,875	-18.1%	-19.5%	-22.0%
0.14	AWV from Republican St to Aurora & Roy St	46,245	52,168	65,661	40,355	44,583	53,925	-12.7%	-14.5%	-17.9%
	Weighted Averages	**99,180**	**106,170**	**118,678**	**85,136**	**90,021**	**98,091**	**-14.2%**	**-15.2%**	**-17.3%**

Time Period & Direction	Wt. Average V/C Without Tolls 1998	2009	2030	Wt. Average V/C With Tolls (Excl. ETC Adjustments) 1998	2009	2030	Percent Change Due to Tolling 1998	2009	2030
AM / PM Peak Periods, Peak Direction	1.01	1.01	1.01	0.87	0.89	0.93	-13.8%	-12.1%	-8.8%
AM / PM Peak Periods, Non-Peak Direction	0.72	0.80	0.96	0.73	0.76	0.82	0.3%	-5.1%	-14.8%
Midday Period, Southbound	0.51	0.54	0.61	0.70	0.70	0.71	36.6%	28.9%	15.4%
Midday Period, Northbound	0.47	0.52	0.62	0.70	0.70	0.71	48.2%	35.0%	13.0%
Night Periods, Both Directions	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table A- 5
Total & Toll Period Vehicle-Miles Traveled by Time Period — Baseline Alternative

Before ETC Non-Participation / Evasion Adjustments

Year	AM Peak (3 hr)		PM Peak (4 hr)		Midday (6 hr)		Night (11 hr)		Weekday (24 hr)		Weekday Tolled (15 hr)		Weekend (24 hr)		Weekend Tolled (15 hr)	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
									100.0%	100.0%	86.2%	85.9%	100.0%	100.0%	77.1%	77.1%
2009	38,995	28,377	37,835	51,994	68,361	70,250	23,331	24,778	168,523	175,398	145,192	150,620	84,261	87,699	64,979	67,630
2010	39,085	28,581	38,108	52,114	68,549	70,506	23,442	24,890	169,185	176,091	145,743	151,201	84,592	88,046	65,234	67,898
2011	39,175	28,787	38,383	52,234	68,738	70,764	23,553	25,003	169,850	176,788	146,296	151,785	84,925	88,394	65,491	68,166
2012	39,266	28,994	38,659	52,354	68,927	71,023	23,666	25,116	170,518	177,488	146,852	152,372	85,259	88,744	65,749	68,436
2013	39,356	29,203	38,938	52,475	69,117	71,283	23,778	25,230	171,189	178,192	147,411	152,961	85,595	89,096	66,007	68,707
2014	39,447	29,414	39,218	52,596	69,307	71,543	23,892	25,345	171,864	178,898	147,972	153,553	85,932	89,449	66,268	68,980
2015	39,538	29,626	39,501	52,718	69,498	71,805	24,005	25,460	172,542	179,608	148,537	154,148	86,271	89,804	66,529	69,254
2016	39,629	29,839	39,785	52,839	69,689	72,067	24,120	25,575	173,223	180,321	149,104	154,746	86,612	90,161	66,792	69,529
2017	39,721	30,054	40,072	52,961	69,881	72,331	24,235	25,691	173,908	181,037	149,673	155,346	86,954	90,519	67,056	69,805
2018	39,812	30,271	40,361	53,083	70,073	72,595	24,350	25,808	174,596	181,757	150,246	155,949	87,298	90,879	67,321	70,082
2019	39,904	30,489	40,652	53,206	70,266	72,861	24,466	25,925	175,288	182,480	150,822	156,555	87,644	91,240	67,588	70,361
2020	39,996	30,708	40,945	53,328	70,459	73,127	24,583	26,043	175,983	183,207	151,400	157,164	87,991	91,603	67,856	70,641
2021	40,089	30,930	41,240	53,451	70,653	73,395	24,700	26,161	176,681	183,937	151,981	157,776	88,340	91,968	68,125	70,923
2022	40,181	31,153	41,537	53,575	70,847	73,663	24,817	26,279	177,382	184,670	152,565	158,390	88,691	92,335	68,395	71,205
2023	40,274	31,377	41,836	53,698	71,042	73,932	24,936	26,399	178,088	185,406	153,152	159,008	89,044	92,703	68,667	71,489
2024	40,367	31,603	42,138	53,822	71,237	74,203	25,054	26,518	178,796	186,146	153,742	159,628	89,398	93,073	68,941	71,775
2025	40,460	31,831	42,441	53,946	71,433	74,474	25,174	26,639	179,508	186,890	154,334	160,251	89,754	93,445	69,215	72,061
2026	40,553	32,060	42,747	54,071	71,630	74,746	25,294	26,760	180,224	187,637	154,930	160,877	90,112	93,818	69,491	72,349
2027	40,647	32,291	43,055	54,196	71,827	75,019	25,414	26,881	180,943	188,387	155,529	161,506	90,471	94,194	69,768	72,639
2028	40,740	32,524	43,365	54,321	72,025	75,294	25,535	27,003	181,666	189,141	156,130	162,138	90,833	94,571	70,047	72,929
2029	40,834	32,758	43,678	54,446	72,223	75,569	25,657	27,126	182,392	189,899	156,735	162,773	91,196	94,949	70,327	73,221
2030	40,929	32,994	43,992	54,571	72,421	75,845	25,779	27,249	183,122	190,660	157,342	163,411	91,561	95,330	70,608	73,515

Note: Toll operations not expected to commence prior to 2009

Table A- 6
Total & Toll Period Vehicle-Miles Traveled by Time Period — Alternative D

Before ETC Non-Participation / Evasion Adjustments

Year	AM Peak (3 hr)		PM Peak (4 hr)		Midday (6 hr)		Night (11 hr)		Weekday (24 hr)		Weekday Tolled (15 hr)		Weekend (24 hr)		Weekend Tolled (15 hr)	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
									100.0%	100.0%	85.7%	85.7%	100.0%	100.0%	77.1%	77.1%
2009	49,244	37,790	50,387	65,658	89,543	89,798	31,470	32,179	220,643	225,425	189,173	193,246	110,322	112,712	85,076	86,920
2010	49,367	38,090	50,786	65,823	89,926	90,158	31,699	32,345	221,778	226,416	190,079	194,070	110,889	113,208	85,514	87,302
2011	49,491	38,391	51,188	65,988	90,311	90,520	31,929	32,512	222,920	227,412	190,990	194,899	111,460	113,706	85,954	87,686
2012	49,615	38,695	51,594	66,153	90,698	90,884	32,161	32,680	224,068	228,413	191,906	195,732	112,034	114,206	86,397	88,072
2013	49,739	39,002	52,003	66,319	91,086	91,249	32,395	32,849	225,223	229,419	192,828	196,570	112,611	114,710	86,842	88,460
2014	49,864	39,311	52,415	66,485	91,476	91,615	32,631	33,019	226,385	230,431	193,754	197,412	113,193	115,215	87,290	88,850
2015	49,989	39,623	52,830	66,652	91,867	91,983	32,868	33,190	227,554	231,448	194,686	198,258	113,777	115,724	87,741	89,242
2016	50,114	39,936	53,249	66,819	92,260	92,353	33,107	33,361	228,730	232,470	195,623	199,108	114,365	116,235	88,194	89,636
2017	50,240	40,253	53,671	66,987	92,655	92,724	33,347	33,534	229,913	233,497	196,566	199,963	114,957	116,748	88,650	90,032
2018	50,366	40,572	54,096	67,155	93,052	93,096	33,590	33,707	231,103	234,529	197,513	200,822	115,552	117,265	89,109	90,430
2019	50,492	40,893	54,524	67,323	93,450	93,470	33,834	33,881	232,301	235,567	198,466	201,686	116,150	117,784	89,571	90,830
2020	50,619	41,217	54,956	67,492	93,850	93,845	34,080	34,056	233,505	236,610	199,425	202,554	116,753	118,305	90,035	91,233
2021	50,746	41,544	55,392	67,661	94,251	94,222	34,328	34,232	234,717	237,659	200,389	203,427	117,358	118,830	90,503	91,637
2022	50,873	41,873	55,831	67,831	94,655	94,601	34,577	34,409	235,936	238,713	201,358	204,304	117,968	119,357	90,973	92,044
2023	51,001	42,205	56,273	68,001	95,060	94,981	34,829	34,587	237,162	239,773	202,333	205,186	118,581	119,886	91,445	92,452
2024	51,128	42,539	56,719	68,171	95,467	95,362	35,082	34,766	238,396	240,838	203,314	206,072	119,198	120,419	91,921	92,863
2025	51,257	42,876	57,168	68,342	95,875	95,745	35,337	34,945	239,637	241,909	204,300	206,963	119,819	120,954	92,400	93,276
2026	51,385	43,216	57,621	68,513	96,286	96,130	35,594	35,126	240,886	242,985	205,292	207,859	120,443	121,492	92,881	93,691
2027	51,514	43,558	58,078	68,685	96,698	96,516	35,853	35,307	242,142	244,066	206,289	208,759	121,071	122,033	93,366	94,108
2028	51,643	43,903	58,538	68,857	97,112	96,903	36,113	35,490	243,406	245,154	207,293	209,664	121,703	122,577	93,853	94,527
2029	51,773	44,251	59,002	69,030	97,527	97,292	36,376	35,673	244,677	246,247	208,301	210,574	122,339	123,123	94,343	94,948
2030	51,902	44,602	59,469	69,203	97,945	97,683	36,640	35,857	245,956	247,346	209,316	211,488	122,978	123,673	94,836	95,372

Note: Toll operations not expected to commence prior to 2009

Table A- 7
Weekday and Weekend Toll Revenue for the Baseline "No Action" Alternative — Constant 2000 Dollars

Year	Gross Weekday Revenue (2000 $)		Adjustments for Truck Toll Rates (+) & ETC Violators/ AVI Non-Participation (–)		Net Weekday Revenue (2000 $)		Gross Weekend Day Revenue (2000 $)		Adjustments for Truck Toll Rates (+) & ETC Violators/ AVI Non-Participation (–)		Net Weekend Day Revenue (2000 $)	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
2009	$9,419	$10,649	($11)	($12)	$9,408	$10,636	$2,215	$2,305	($3)	($3)	$2,212	$2,303
2010	$9,517	$10,755	($11)	($13)	$9,506	$10,742	$2,224	$2,314	($3)	($3)	$2,221	$2,312
2011	$9,617	$10,862	($11)	($13)	$9,606	$10,849	$2,232	$2,324	($3)	($3)	$2,230	$2,321
2012	$9,719	$10,971	($11)	($13)	$9,708	$10,958	$2,241	$2,333	($3)	($3)	$2,239	$2,330
2013	$9,822	$11,081	($11)	($13)	$9,811	$11,068	$2,250	$2,342	($3)	($3)	$2,247	$2,339
2014	$9,927	$11,193	($12)	($13)	$9,916	$11,180	$2,259	$2,351	($3)	($3)	$2,256	$2,349
2015	$10,034	$11,307	($12)	($13)	$10,022	$11,293	$2,268	$2,361	($3)	($3)	$2,265	$2,358
2016	$10,142	$11,422	($12)	($13)	$10,130	$11,408	$2,277	$2,370	($3)	($3)	$2,274	$2,367
2017	$10,252	$11,538	($12)	($13)	$10,240	$11,525	$2,286	$2,379	($3)	($3)	$2,283	$2,377
2018	$10,364	$11,657	($12)	($14)	$10,352	$11,643	$2,295	$2,389	($3)	($3)	$2,292	$2,386
2019	$10,478	$11,777	($12)	($14)	$10,466	$11,763	$2,304	$2,398	($3)	($3)	$2,301	$2,396
2020	$10,594	$11,899	($12)	($14)	$10,581	$11,885	$2,313	$2,408	($3)	($3)	$2,310	$2,405
2021	$10,711	$12,022	($13)	($14)	$10,698	$12,008	$2,322	$2,418	($3)	($3)	$2,319	$2,415
2022	$10,830	$12,147	($13)	($14)	$10,818	$12,133	$2,331	$2,427	($3)	($3)	$2,329	$2,424
2023	$10,952	$12,275	($13)	($14)	$10,939	$12,260	$2,341	$2,437	($3)	($3)	$2,338	$2,434
2024	$11,075	$12,403	($13)	($14)	$11,062	$12,389	$2,350	$2,447	($3)	($3)	$2,347	$2,444
2025	$11,200	$12,534	($13)	($15)	$11,187	$12,520	$2,359	$2,456	($3)	($3)	$2,357	$2,453
2026	$11,328	$12,667	($13)	($15)	$11,315	$12,652	$2,369	$2,466	($3)	($3)	$2,366	$2,463
2027	$11,458	$12,802	($13)	($15)	$11,444	$12,787	$2,378	$2,476	($3)	($3)	$2,375	$2,473
2028	$11,589	$12,938	($14)	($15)	$11,576	$12,923	$2,388	$2,486	($3)	($3)	$2,385	$2,483
2029	$11,723	$13,077	($14)	($15)	$11,710	$13,062	$2,397	$2,496	($3)	($3)	$2,394	$2,493
2030	$11,860	$13,218	($14)	($15)	$11,846	$13,202	$2,407	$2,506	($3)	($3)	$2,404	$2,503

Table A- 8
Weekday and Weekend Toll Revenue for the Baseline "No Action" Alternative — Inflated Dollars

Year	Gross Weekday Revenue (Inflated $)		Adjustments for Truck Toll Rates (+) & ETC Violators/ AVI Non-Participation (–)		Net Weekday Revenue (Inflated $)		Gross Weekend Day Revenue (Inflated $)		Adjustments for Truck Toll Rates (+) & ETC Violators/ AVI Non-Participation (–)		Net Weekend Day Revenue (Inflated $)	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
2009	$11,307	$12,783	($13)	($15)	$11,294	$12,768	$2,659	$2,767	($3)	($3)	$2,656	$2,764
2010	$11,689	$13,208	($14)	($15)	$11,675	$13,193	$2,731	$2,842	($3)	($3)	$2,728	$2,839
2011	$12,104	$13,671	($14)	($16)	$12,090	$13,655	$2,810	$2,924	($3)	($3)	$2,806	$2,921
2012	$12,569	$14,188	($15)	($17)	$12,554	$14,171	$2,898	$3,017	($3)	($4)	$2,895	$3,013
2013	$13,066	$14,740	($15)	($17)	$13,051	$14,723	$2,993	$3,115	($3)	($4)	$2,989	$3,112
2014	$13,580	$15,311	($16)	($18)	$13,564	$15,293	$3,090	$3,216	($4)	($4)	$3,086	$3,213
2015	$14,120	$15,911	($16)	($19)	$14,103	$15,892	$3,191	$3,322	($4)	($4)	$3,187	$3,318
2016	$14,690	$16,543	($17)	($19)	$14,673	$16,523	$3,297	$3,433	($4)	($4)	$3,294	$3,429
2017	$15,304	$17,224	($18)	($20)	$15,287	$17,204	$3,412	$3,552	($4)	($4)	$3,408	$3,548
2018	$15,987	$17,981	($19)	($21)	$15,968	$17,960	$3,540	$3,685	($4)	($4)	$3,536	$3,681
2019	$16,733	$18,807	($20)	($22)	$16,713	$18,785	$3,679	$3,830	($4)	($4)	$3,675	$3,826
2020	$17,560	$19,723	($21)	($23)	$17,539	$19,700	$3,834	$3,991	($4)	($5)	$3,830	$3,987
2021	$18,187	$20,413	($21)	($24)	$18,166	$20,389	$3,943	$4,105	($5)	($5)	$3,938	$4,100
2022	$18,841	$21,133	($22)	($25)	$18,819	$21,108	$4,056	$4,223	($5)	($5)	$4,051	$4,218
2023	$19,532	$21,891	($23)	($26)	$19,509	$21,865	$4,174	$4,346	($5)	($5)	$4,170	$4,341
2024	$20,256	$22,685	($24)	($27)	$20,232	$22,659	$4,298	$4,475	($5)	($5)	$4,293	$4,469
2025	$21,007	$23,509	($25)	($27)	$20,982	$23,481	$4,425	$4,607	($5)	($5)	$4,420	$4,602
2026	$21,793	$24,369	($25)	($28)	$21,768	$24,341	$4,557	$4,745	($5)	($6)	$4,552	$4,739
2027	$22,625	$25,279	($26)	($30)	$22,599	$25,250	$4,696	$4,889	($5)	($6)	$4,691	$4,884
2028	$23,495	$26,230	($27)	($31)	$23,467	$26,199	$4,840	$5,040	($6)	($6)	$4,835	$5,034
2029	$24,403	$27,221	($29)	($32)	$24,375	$27,189	$4,990	$5,195	($6)	($6)	$4,984	$5,189
2030	$25,353	$28,256	($30)	($33)	$25,323	$28,223	$5,145	$5,357	($6)	($6)	$5,139	$5,351

Table A- 9
Weekday and Weekend Daily Toll Revenue for "Alternative D" — Constant 2000 Dollars

Year	Gross Weekday Revenue (2000 $)		Adjustments for Truck Toll Rates (+) & ETC Violators/ AVI Non-Participation (–)		Net Weekday Revenue (2000 $)		Gross Weekend Day Revenue (2000 $)		Adjustments for Truck Toll Rates (+) & ETC Violators/ AVI Non-Participation (–)		Net Weekend Day Revenue (2000 $)	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
2009	$10,952	$12,128	($13)	($14)	$10,939	$12,114	$2,600	$2,656	($3)	($3)	$2,597	$2,653
2010	$11,104	$12,274	($13)	($14)	$11,091	$12,260	$2,631	$2,686	($3)	($3)	$2,627	$2,682
2011	$11,258	$12,423	($13)	($15)	$11,245	$12,408	$2,662	$2,715	($3)	($3)	$2,659	$2,712
2012	$11,416	$12,574	($13)	($15)	$11,403	$12,559	$2,693	$2,745	($3)	($3)	$2,690	$2,742
2013	$11,577	$12,727	($14)	($15)	$11,563	$12,713	$2,725	$2,776	($3)	($3)	$2,722	$2,773
2014	$11,741	$12,884	($14)	($15)	$11,727	$12,869	$2,757	$2,807	($3)	($3)	$2,754	$2,803
2015	$11,908	$13,043	($14)	($15)	$11,894	$13,027	$2,790	$2,838	($3)	($3)	$2,787	$2,835
2016	$12,078	$13,204	($14)	($15)	$12,064	$13,189	$2,823	$2,869	($3)	($3)	$2,820	$2,866
2017	$12,252	$13,369	($14)	($16)	$12,238	$13,353	$2,857	$2,901	($3)	($3)	$2,853	$2,898
2018	$12,430	$13,536	($15)	($16)	$12,415	$13,521	$2,891	$2,933	($3)	($3)	$2,887	$2,930
2019	$12,611	$13,707	($15)	($16)	$12,596	$13,691	$2,925	$2,966	($3)	($3)	$2,922	$2,963
2020	$12,796	$13,880	($15)	($16)	$12,781	$13,864	$2,960	$2,999	($3)	($4)	$2,956	$2,996
2021	$12,985	$14,057	($15)	($16)	$12,969	$14,041	$2,995	$3,032	($3)	($4)	$2,991	$3,029
2022	$13,177	$14,237	($15)	($17)	$13,162	$14,220	$3,031	$3,066	($4)	($4)	$3,027	$3,063
2023	$13,374	$14,420	($16)	($17)	$13,358	$14,403	$3,067	$3,100	($4)	($4)	$3,063	$3,097
2024	$13,574	$14,607	($16)	($17)	$13,559	$14,589	$3,103	$3,135	($4)	($4)	$3,099	$3,131
2025	$13,779	$14,796	($16)	($17)	$13,763	$14,779	$3,140	$3,170	($4)	($4)	$3,136	$3,166
2026	$13,989	$14,990	($16)	($18)	$13,972	$14,972	$3,177	$3,205	($4)	($4)	$3,174	$3,201
2027	$14,202	$15,187	($17)	($18)	$14,186	$15,169	$3,215	$3,241	($4)	($4)	$3,211	$3,237
2028	$14,420	$15,388	($17)	($18)	$14,404	$15,370	$3,254	$3,277	($4)	($4)	$3,250	$3,273
2029	$14,643	$15,592	($17)	($18)	$14,626	$15,574	$3,292	$3,313	($4)	($4)	$3,288	$3,310
2030	$14,871	$15,801	($17)	($18)	$14,854	$15,783	$3,332	$3,350	($4)	($4)	$3,328	$3,346

Table A- 10
Weekday and Weekend Toll Revenue for "Alternative D" — Inflated Dollars

Year	Gross Weekday Revenue (Inflated $)		Adjustments for Truck Toll Rates (+) & ETC Violators/ AVI Non-Participation (–)		Net Weekday Revenue (Inflated $)		Gross Weekend Day Revenue (Inflated $)		Adjustments for Truck Toll Rates (+) & ETC Violators/ AVI Non-Participation (–)		Net Weekend Day Revenue (Inflated $)	
	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB
2009	$13,147	$14,560	($15)	($17)	$13,132	$14,543	$3,121	$3,189	($4)	($4)	$3,117	$3,185
2010	$13,637	$15,075	($16)	($18)	$13,621	$15,057	$3,231	$3,298	($4)	($4)	$3,227	$3,294
2011	$14,170	$15,635	($17)	($18)	$14,153	$15,617	$3,350	$3,417	($4)	($4)	$3,346	$3,413
2012	$14,763	$16,261	($17)	($19)	$14,746	$16,242	$3,483	$3,550	($4)	($4)	$3,479	$3,546
2013	$15,399	$16,930	($18)	($20)	$15,381	$16,910	$3,625	$3,693	($4)	($4)	$3,621	$3,688
2014	$16,060	$17,623	($19)	($21)	$16,041	$17,603	$3,772	$3,839	($4)	($4)	$3,767	$3,835
2015	$16,757	$18,354	($20)	($21)	$16,737	$18,332	$3,926	$3,993	($5)	($5)	$3,922	$3,989
2016	$17,494	$19,125	($20)	($22)	$17,473	$19,102	$4,089	$4,156	($5)	($5)	$4,084	$4,151
2017	$18,290	$19,957	($21)	($23)	$18,269	$19,933	$4,264	$4,331	($5)	($5)	$4,259	$4,326
2018	$19,174	$20,880	($22)	($24)	$19,151	$20,856	$4,459	$4,525	($5)	($5)	$4,454	$4,520
2019	$20,139	$21,889	($24)	($26)	$20,116	$21,863	$4,671	$4,737	($5)	($6)	$4,666	$4,731
2020	$21,211	$23,008	($25)	($27)	$21,186	$22,981	$4,906	$4,971	($6)	($6)	$4,900	$4,966
2021	$22,048	$23,869	($26)	($28)	$22,022	$23,841	$5,085	$5,149	($6)	($6)	$5,079	$5,143
2022	$22,924	$24,768	($27)	($29)	$22,897	$24,739	$5,272	$5,334	($6)	($6)	$5,266	$5,328
2023	$23,851	$25,717	($28)	($30)	$23,824	$25,687	$5,469	$5,529	($6)	($6)	$5,463	$5,523
2024	$24,827	$26,715	($29)	($31)	$24,798	$26,683	$5,675	$5,733	($7)	($7)	$5,669	$5,727
2025	$25,844	$27,751	($30)	($32)	$25,814	$27,719	$5,889	$5,945	($7)	($7)	$5,882	$5,938
2026	$26,912	$28,838	($31)	($34)	$26,880	$28,805	$6,113	$6,166	($7)	($7)	$6,106	$6,159
2027	$28,045	$29,990	($33)	($35)	$28,012	$29,955	$6,349	$6,400	($7)	($7)	$6,342	$6,392
2028	$29,234	$31,195	($34)	($36)	$29,200	$31,159	$6,596	$6,643	($8)	($8)	$6,588	$6,635
2029	$30,481	$32,457	($36)	($38)	$30,446	$32,419	$6,853	$6,897	($8)	($8)	$6,845	$6,889
2030	$31,790	$33,778	($37)	($39)	$31,753	$33,739	$7,122	$7,162	($8)	($8)	$7,114	$7,154